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EDITORIAL

Holes in Rubber Gloves

TWENTY-EIGHT years ago Hunt [1] found that fifteen of twenty-eight clean operative wounds contained pathogenic bacteria. In the intervening years bacteriologic techniques have been constantly improved, operating rooms have been devised, and operating room methods have been developed to reduce contamination of wounds with infectious agents. Yet Wise and his associates [2] in 1959 found that 80 per cent of seventy-one clean surgical wounds contained pathogenic bacteria.

The exact relationship between an infection and the bacterial environment is certainly not known. It appears obvious that operations carried out in a totally sterile environment should not become infected. Yet the converse is certainly not true. There are many imponderables in this problem. Why should a patient develop a staphylococcal infection in a stitch hole which traverses the incision while the main wound heals per primam without any inflammatory signs? Why do certain obviously contaminated wounds heal without infection? Why does one furuncle spread to the contiguous skin glands and become a carbuncle, while another furuncle leads to other similar abscesses on other parts of the body surface?

Obviously nothing should deter us from every effort to secure as asceptic a technique as possible, for we know that bacterial sources must ultimately be the cause of wound infection. One of the most neglected sources of bacterial contamination is the surgeons' gloved hands. This is surprising. The surgical scrub has been the source of much renewed interest in recent years, particularly since the addition of hexachlorophene to soaps and detergents used in the scrub. The hands of the surgeon are in constant contact with the operative wound.

It has been amply shown that even the scrubbed hand is redolent with bacteria. The use of rubber gloves has been unquestioningly adopted in every operative clinic in the United States and in every major institution throughout the entire world. Wise has shown that the inner surfaces of only 2 per cent of gloves are sterile when they are removed. It has been shown [3] that bacteria migrate freely through the most minute holes in rubber gloves. Watson-Jones [4] states that this is the major source of bacterial contamination of wounds.

Nevertheless there are surgeons who suggest that holes in rubber gloves are of little significance. Walter [5] has called attention to a disgusting example wherein a surgeon asked an attendant to wipe the pus draining from a furuncle on his back while he was operating, a

[1] HUNT, E. L. Some further observations on contamination of operative wounds by airborne bacteria. *New England J. Med.*, 209: 931, 1933.

[2] WISE, R. I., SWEENEY, F. J., HAUPT, G. S. and WADDELL, M. A. The environmental distribution of staphylococcus aureus in an operating suite. *Ann. Surg.*, 149: 30, 1959.

[3] BECK, W. C. A new instrument to detect holes in rubber gloves. *Guthrie Clin. Bull.*, 29: 14, 1959.

[4] WATSON-JONES, SIR R. and JONES, R. Infections in trauma. Abstracts of Forty-seventh Clinical Congress, American College of Surgeons. *Hosp. Topics*, 3: 22, 1959.

[5] WALTER, C. W. Panel discussion: The hospital environment. Proceedings of the International Colloquialism on Resistant Infections. World Medical Association, Norwich, N. Y., 1958.

practice which the great majority of surgeons would condemn. Yet many surgeons will continue an operative procedure after discovering that a hole has developed in a glove.

An instrument has been developed for the detection of holes in rubber gloves [3] during an operative procedure. This device is based upon the principle that a rubber glove is an electrical insulator. A very small current of under five volts and in the milliamphere range is interposed in a circuit from the wash basin to the floor. The surgeon, wearing conductive shoes, stands on the floor and the current passes through his body. When he dips his hands into the wash basin, if there is a hole in the glove, the circuit is completed and is registered on a meter. The meter remains inactive if there is no hole in the glove. Thus, if all of the members of the operative team repeatedly dip their hands into the basin during an operation, the integrity of their gloves is insured.

By the use of this device, we have found that a definite percentage of even new, unused rubber gloves contain holes. This suggests that more adequate testing methods are needed in manufacturing gloves, and that standards need to be devised so that surgeons may wear gloves with confidence.

Surgeons must retain a methodology in the surgical scrub which will insure a minimum of contamination if rubber gloves are torn. They must also discard the glove immediately upon discovery of a hole, no matter how small. And last but not least, the manufacturers of rubber gloves should develop testing methods which will insure the integrity of new gloves.

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[3] BECK, W. C. A new instrument to detect holes in rubber gloves. *Guthrie Clin. Bull.*, 29: 14, 1959.

Primary Carcinoma of the Gallbladder*

REPORT OF FORTY-SEVEN CASES

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CARCINOMA of the gallbladder is usually a surgically hopeless entity. In the early stage of this highly malignant neoplasm, when extirpative therapy might be of some value, the preoperative diagnosis is inherently difficult to establish.

According to the U. S. Bureau of Census, more than 10,000 of 150,000 annual deaths from cancer are due to cancer of the liver and biliary passages. Cancer of the gallbladder accounts for about two-thirds of these, or 6,500 deaths yearly.

This communication reports forty-seven new cases of this condition seen at St. Alexis Hospital, Cleveland, Ohio, between 1945 and 1957, and correlates data derived from other hospitals in the city of Cleveland during the same period. These cases are compared with those previously reported in the literature. A comprehensive picture of the morbid anatomic and clinical aspects of the disease is discussed.

The clinical and operative records, necropsy protocols, histologic sections and photographs of these cases were carefully reviewed.

ETIOLOGY

Much attention in the literature has been focused upon the frequent simultaneous occurrence of carcinoma of the gallbladder and gallstones. Many investigators believe that an etiologic basis in this association exists, some holding that the calculi predispose to the carcinomatous condition in the gallbladder, others contending that the reverse might be true.

The frequency with which calculi are present in primary carcinoma of the gallbladder and their known presence prior to the cancer, as well as the experimental production of carcinoma by insertion of foreign bodies into the gallbladder of the experimental animal, support the contention than an etiologic relationship may exist.

In the forty-seven patients of this series, gallstones were found in thirty-eight (80 per cent). One patient presented a cholecystoduodenocolic fistula and had no stones in the gallbladder, but one calculus less than 1.0 cm. in its greatest dimension was found in the right hepatic duct at autopsy, suggesting that cholelithiasis may have been present and the stones "passed" by the fistula. The operative records of two patients made no mention of the presence or absence of stones, but stones were demonstrated on oral cholecystograms. This constitutes an incidence of forty-one gallstones in forty-seven patients with cancer (87 per cent).

In two of the patients in whom no stones were found, the diffuse carcinomatous growth was hard and cartilaginous, and palpation did not indicate the presence or absence of stones. One diagnosis was made by Silverman needle biopsy, and autopsy was not performed. This patient was jaundiced. In only three cases (6.38 per cent) was there definite absence of

* This article is an abridgment of the thesis presented at the completion of a general surgical residency at St. Alexis Hospital, Cleveland, Ohio.

TABLE I
CALCULI, PRECURSORS OF CANCER

Age (yr.) and Sex	Time of Cholecystography	Time of Cholecystostomy	Development of Cancer	Time Interval (yr.)
65, F	11/20/44		5/28/55	11
55, F		1944	4/28/53	9
61, F		1923	11/7/55	32
63, F	9/7/54		8/16/55	1
66, M	11/5/51		11/23/56	5

gallstones on roentgenographic examination and at exploration.

The marked predilection of cancer of the gallbladder in women has been attributed to the preponderate incidence of cholelithiasis in the female.

Five patients in our series were known to have gallstones for varying periods of time before the cancer developed in the gallbladder. Table 1 indicates the time interval between discovery of the gallstones by cholecystogram or cholecystostomy and the development of the cancer and associated cholelithiasis.

EXPERIMENTAL PRODUCTION OF CARCINOMA OF THE GALLBLADDER

Many investigators have endeavored to produce tumors of the gallbladder in animals by introducing foreign bodies such as pebbles, suture materials, lanolin, paraffin, pitch, tar, cement, tile, fragments and gallstones with or without radium. Both calculi and cancer may be developed in response to a common agency. Such an occurrence has been known to occur in the kidney. Daels and Biltris [*10,11*] inserted a strip of collodion impregnated with radium sulfate into the kidney of a guinea pig which twenty-two months later was found to have lithiasis and sarcoma of that kidney.

Kazama [*20*] introduced a foreign body into the gallbladder of ninety-eight guinea pigs and produced cancer in twenty-six, nine with metastases. Leitch [*23*], in 1924, undertook a repetition of Kazama's experiments and reported that he produced malignant lesions in the gallbladder of guinea pigs by introducing human gallstones. Delbet and Godard [*13*] inserted gallstones from cancerous patients into the gallbladder of six guinea pigs and from non-cancerous patients into ten guinea pigs. Similar results followed in both groups. A thickening of the wall of the gallbladder was found with pronounced hyperplasia of the glandular elements which formed cysts and tended to invade the liver. In two of these animals, the appearance was suggestive of cancer. In 1947, Petrov and Krotkina [*28*] also found the development of malignant growth after introduction of hard foreign bodies into the gallbladder of guinea pigs.

More recently, Fortner [*15*] introduced methylcholanthrene fashioned into pressure pellets into the gallbladder of fourteen young cats after aspiration of bile and ligation of the cystic duct to prevent dissolution of the pellets. Eight cats died within ten months from respiratory infections. Five of the remaining six cats exposed for twenty-three months or more were found to have primary carcinoma of the gallbladder.

Methylcholanthrene and cholanthrene are highly potent carcinogenic hydrocarbons. Chemically, they are closely related to the bile acids from which they can be prepared by simple chemical steps. Future research may well ascertain whether or not gallstones or the contents of the bile from subjects of carcinoma of the biliary tract contain methylcholanthrene or any related carcinogenic substance.

The association of carcinoma of the gallbladder with gallstones almost certainly has etiologic significance for there is strong evidence that the stones commonly precede the cancer and do not merely result from its presence. The mechanical irritation of calculi, the relation to a peculiar form of lipoid metabolism, and the irritative and digestive action of bile may combine to produce the remarkable susceptibility of this mucous membrane to cancer.

The statistics and experimental data are convincing enough to suggest that cholelithiasis is a common predisposing factor and precursor of carcinoma in the gallbladder. For this reason, cholecystectomy is advised for those patients after the age of forty with symptoms and non-visualization of the gallbladder on double-dose oral cholecystograms.

DATA

Incidence. During the twelve-year period from 1945 to 1957 there were forty-seven cases in which a microscopic diagnosis of primary carcinoma of the gallbladder was recorded at St. Alexis Hospital. This series includes two

autopsy findings and forty-five operative specimens.

There were twelve men and thirty-five women, a ratio of 1 man to 3 women. The distribution of the patients according to age and sex is shown in Table II.

It is of interest to note that 25 per cent of the patients were in the fifth decade, 52 per cent of the patients were in the sixth decade, and 71 per cent of the patients were over sixty years old. Ninety-six per cent of the patients with this condition are over the age of fifty. The average age for men in the group was sixty-one years, for women in the group sixty-four, and for the entire group sixty-three.

The youngest patient in the group of men was forty years of age, the oldest seventy-nine. In the group of women the youngest was fifty and the oldest seventy-eight. Women in the sixth decade numbered twenty-one, or 45 per cent.

A comparative study was made from hospitals in the Cleveland area of carcinoma of the gallbladder in relation to the number of admissions and cholecystectomies performed. Table III represents a correlation of these figures. It will be noted that our percentage of carcinoma of the gallbladder was the highest.

Pathology. Carcinoma of the gallbladder starts anywhere in the organ and infiltrates the viscus locally, causing thickening and stiffening of the wall at the site of involvement. Some growths protrude into the lumen as irregular, small or bulky, firm or soft masses. More frequently the growth infiltrates the entire viscus and by direct extension upward involves the liver or downward, the porta hepatis and the common bile duct as well as the pancreas and duodenum.

TABLE II
AGE AND SEX DISTRIBUTION

Age (yr.)	No. of Men	No. of Women	Total	Per cent
40–49	2	...	2	4
50–59	4	8	12	25
60–69	3	21	24	52
70–79	3	6	9	19
Total	12	35	47	
Average	61	64	63	

Microscopically, the majority of carcinomas of the gallbladder are columnar cells of varying heights, mounted on delicate connective tissue stalks, or that form acinar tubular structures in a scanty or more abundant, loose or dense fibrous connective tissue stroma. Occasionally the columnar cells produce mucin in abundance. In other instances, a squamous cell carcinoma is encountered in the gallbladder secondary to metaplasia.

In the forty-seven cases of our series, there were forty-three adenocarcinomas (91.49 per cent), three squamous cell carcinomas (6.38 per cent) and one sarcoma (2.13 per cent).

Symptomatology. The major symptoms relative to the present illness which the forty-seven patients presented at the time of admission were as follows:

Thirty-six patients complained of dull, aching pain in the right upper quadrant of the abdomen which required their taking occasional

TABLE III
DATA FROM HOSPITALS IN CLEVELAND (1945 TO TIME OF WRITING)

Hospitals	Bed Capacity	No. of Admissions	Cholecystectomies Performed	Cases of Carcinoma of Gallbladder	Per cent
Huron Road Hospital	419	178,229	2,064	30	1.45
Marymount Hospital	229	61,121	683	9	1.31
Lutheran Hospital	189	107,218	1,432	29	2.02
St. Vincent Charity Hospital	364	112,255	1,706	35	2.05
Cleveland Clinic Hospital	493	136,106	1,722*	36*	2.09
St. John's Hospital	316	100,000	1,870	47	2.51
St. Alexis Hospital	326	148,689	1,717	47	2.73
Total	2,336	843,618	11,194	233	2.08

* The records of 1957 are incomplete.

TABLE IV
SYMPTOMS ON ADMISSION

Symptom	No. of Cases	Per cent	Minimum	Maximum
Intolerance to fatty foods	38	81	6 mo.	Several years
Pain in right upper quadrant	36	76	2 days	Several years
Loss of weight	23	49	10 lb. in 6 mo.	70 lb. in 3 mo.
Dark urine, clay-colored stools	18	38	3 days	1 wk.
Weakness	17	36	2 wk.	4 mo.
Jaundice	14	30	3 days	2 mo.
Anorexia	9	19	3 mo.	6 mo.
Nausea, vomiting	7	15	2 days	1 wk.

narcotics for alleviation. The pain was usually in the right upper quadrant; less frequently it referred to the epigastrium and least frequently to the right lower quadrant.

In thirty-eight of our forty-seven cases, there was a history suggestive of gallbladder disease with intolerance to fatty foods of several years' duration. Our hospital patients are mainly of Polish, Bohemian and Slovenian ancestry who are known for their consumption of high fatty diets comprised of pork, sauerkraut, pigs-in-the-blanket and kolbasa.

Other symptoms such as weakness, loss of weight and anorexia completed the clinical picture and were occasionally suggestive of malignancy. Table IV summarizes the symptoms present in the forty-seven cases.

Attention is directed to three cases of carcinoma of the gallbladder which were silent, without symptoms, and noted as incidental findings.

Routine roentgenographic examination in one patient disclosed a herniation of the entire stomach and part of the transverse colon through the diaphragm behind the heart. A barium swallow test revealed a cholecystoduodenocolic fistula. Autopsy revealed a squamous cell carcinoma of the gallbladder.

Another patient who underwent pelvic laparotomy was found to have 800 cc. of blood-stained peritoneal effusion, and the peritoneum was studded with hard metastatic nodules from a primary carcinoma of the gallbladder.

In a third patient, autopsy disclosed a non-suspected adenocarcinoma of the gallbladder associated with an acute suppurative pancreatitis. Clinically, the patient was admitted for an ischemic necrosis of the left lower extremity secondary to the obstruction of the left external iliac artery.

Physical Signs. A mass in the right upper quadrant thought to be the liver or gallbladder was the most important physical finding. Ascites was present in seven patients, and at paracentesis the liquid removed varied from a clear, cloudy amber fluid, blood-stained peritoneal effusion to a pure hemoperitoneum ranging in amount from 800 to 4,000 cc. The mechanism of ascites in these cases is not always clear-cut and may be due to such factors as carcinomatosis of the peritoneum or mesentery, obstruction of the portal vein by a neoplasm, thrombosis of the portal or hepatic veins, or cirrhosis of the liver with hypoproteinemia.

Jaundice was present in fourteen patients on admission but was subsequently noted in twenty-six patients during the clinical course. In the majority of cases, the jaundice was persistent, painless, afebrile and progressive; in eighteen patients it was associated with dark urine and clay-colored stools.

Radiographic Findings. Twenty-seven patients had radiographic examinations at a date varying from a few days to eleven years prior to the proved diagnosis of carcinoma of the gallbladder. Oral cholecystography revealed visualization of the gallbladder with stones in two patients, non-visualization of the gallbladder with stones in thirteen, and non-visualization of the gallbladder in eleven. In one patient, an upper gastrointestinal series revealed a cholecystoduodenocolic fistula which at autopsy proved to be a squamous cell carcinoma of the gallbladder.

Preoperative Diagnosis and Location of Carcinoma. In the forty-seven cases, there were only four instances in which the surgeon considered the diagnosis of primary carcinoma of the gallbladder as the first impression. Table V lists the different clinical diagnoses made prior to surgery.

Not only is the clinical diagnosis difficult, but accurate location of the primary lesion even at the time of laparotomy is often fraught with considerable difficulty. Table VI summarizes the location of the primary tumor according to the operative records.

Operative Procedures. At the time of surgery the usual extent of the disease, the common involvement of the liver and perihepatic or celiac lymph nodes suggested that any attempt at radical surgery was unjustifiable and that a

TABLE V
PREOPERATIVE DIAGNOSIS

Diagnosis	No. of Cases
Acute cholecystitis	8
Chronic cholecystitis with lithiasis	8
Obstructive jaundice	1
Obstructive jaundice (stone)	3
Obstructive jaundice (tumor)	10
Carcinoma of pancreas with metastases to liver	5
Carcinoma of liver	5
Indeterminate	3
Carcinoma of the gallbladder	4

TABLE VI
SITE OF CARCINOMA

Site of Primary Tumor	No. of Cases
Diffuse growth in gallbladder with extension to liver, bile ducts, nodes (omentum, retroperitoneal space) (periaortic and perihepatic)	28
Gallbladder fundus with direct extension to liver	6
Gallbladder fundus alone	2
Lower half of gallbladder with liver involvement	8
Cystic duct only	1
Not operated	2

palliative procedure was indicated. Whenever possible, of course, cholecystectomy was performed. In one patient, carcinoma of the gallbladder with direct extension to the immediate surrounding liver parenchyma was successfully treated by cholecystectomy and associated wedge resection of the liver.

The operative procedures performed in this series are listed in Table VII.

In one patient, the pathology was mistaken for acute cholecystitis and cholecystostomy was performed. Progressively increasing jaundice developed postoperatively and the patient required re-exploration, at which time a biopsy proved the diagnosis of carcinoma of the gallbladder.

Prognosis and Survival. The disease was rapidly fatal, leading to death in the first postoperative month in sixteen cases (34 per cent).

TABLE VII
TYPE OF OPERATIONS PERFORMED

Operation	No. of Cases
Cholecystectomy	11
Cholecystectomy and wedge resection of liver	1
Cholecystostomy	1
Cholecystostomy and biopsy of gallbladder	15
Biopsy of gallbladder	6
Biopsy of liver	1
Biopsy of omentum	2
Biopsy of liver and omentum	2
Biopsy of liver and gallbladder	2
Cholecystostomy, biopsy of liver and gallbladder	3
Silverman needle biopsy	1
Not operated, autopsied	2

Thirty-two patients (68 per cent) died in the first three months following surgery. Over 83 per cent died in the first six months. (Table VIII.)

Three patients lived 349, 394 and 533 days, respectively, while one patient with a fifteen-year survival was not included because the microscopic sections were unavailable. The patient surviving 533 days had carcinoma of the fundus of the gallbladder with gross extension to the immediate surrounding liver parenchyma which required cholecystectomy and wedge resection of the liver.

Four patients (8.5 per cent) with carcinoma of the gallbladder in our series are alive and well today. (Table IX.) These four were treated by cholecystectomy only. In two, the microscopic sections revealed carcinoma of the fundus of the gallbladder with extension to serosa, and they have survived one and a half years and two years, eight months, respectively. One patient with grossly chronic cholecystitis was reported as having partially differentiated adenocarcinoma with cholelithiasis; the patient,

TABLE VIII
POSTOPERATIVE SURVIVAL

Time of Death	No. of Cases	Per cent
Day of operation	1	2.12
1 to 10 days postoperatively	5	10.63
11 to 30 days postoperatively	10	21.27
1 mo. to 3 mo. postoperatively	16	34.04
3 mo. to 6 mo. postoperatively	5	10.63
Autopsy findings	2	4.25
Total	39	83

TABLE IX
OPERATED AND STILL ALIVE

Age (yr.) and Sex	Date of Operation	Operation Performed	Alive
70, M	11/19/52	Cholecystectomy	5½ yr.
62, M	9/21/50	Cholecystectomy	7½ yr.
67, F	11/7/56	Cholecystectomy	1½ yr.
63, F	8/16/55	Cholecystectomy	2 yr., 8 mo.

then a seventy year old white woman, represents a five and a half-year cure. In the fourth patient, who had carcinoma of the cystic duct and underwent cholecystectomy on September 21, 1950, jaundice developed in 1957 and resection of a segment of the common bile duct was performed for an obstructive malignant lesion. The patient is symptom-free at present.

SUMMARY

Forty-seven cases of primary carcinoma of the gallbladder are reported, forty-five of which included operative specimens.

The sex incidence was one man to three women; the youngest patient was forty years of age, the oldest seventy-nine.

Three cases of clinically silent, symptom-free carcinoma of the gallbladder are reported. The diagnosis of carcinoma of the gallbladder preoperatively is difficult and rare.

The etiologic role of cholelithiasis predisposing to the carcinomatous condition is discussed and supported by clinical and experimental data.

Surgical therapy in carcinoma of the gallbladder is usually palliative and the life expectancy is poor. Four patients alive for varying intervals following surgery are presented; one is surviving five and a half years postoperatively; the other, seven and a half years.

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Reappraisal of Radical Fasciectomy for Dupuytren's Contracture

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THERE are few places in the entire field of surgery in which an operation may produce more disability and morbidity than it is intended to cure. This happens with sufficient frequency in radical palmar fasciectomy for Dupuytren's contracture that a careful reappraisal of our surgical approach seems indicated. All too often, six months to a year after a meticulous, careful, even "beautiful" operation for Dupuytren's contracture, the patient has a semi-frozen, stiff hand, still showing edema and rubor, and is not yet able to close his fist tightly. Is this good surgery? Add to this the report of Gordon [5], who found recurrence and/or extension in 35.8 per cent of 120 operated cases, and one must realize that this is not a simple problem.

The natural history of the disease, which is benign, and the disability produced by the contracture, which is surprisingly small even in advanced stages, balanced against radical fasciectomy in a poor-risk patient would definitely contraindicate the procedure. With the better-risk patient, the surgical indications are still often questionable. Thus we are left with the good-risk patient as the only one in whom radical operation is advisable. Appraisal of the "good risk," however, involves more than the factors of risk in other general surgical problems, and includes local factors of great importance.

Palpation of the affected hand by the examiner will reveal much to influence his judgment in an individual case. The hand which feels stiff or hard or cold to the examiner, or which shows Heberden's nodes or other arthritic stigmas, should be rejected for the most radical procedures. Advanced age, the collagenous diseases or associated systemic disease should also preclude total fasciectomy in most cases Extreme contracture is often treated better by partial digital amputation than by fasciectomy. The disability following amputation is often surprisingly slight and the relief to the patient is considerable.

What, then, can be done to relieve contracture in those in whom the surgeon deems it feasible to proceed with surgery? Since Dupuytren's contracture affects approximately 2 per cent of the population, this is a fairly common problem. First, a careful selection of patients is of paramount importance, as mentioned previously. Radical extirpation of the palmar fascia with all its interpolated ramifications is still the treatment of choice in the younger patient. There should be only early nodular thickening and slight contracture; the hand should be warm and supple. Contralateral occurrence in the same patient or a strong family history of the disease indicates probable progressive contracture which should be an additional indication. In addition, one should avoid operating upon those persons with concurrent associated disease, such as coronary heart disease, gout, Reynaud's disease, other cardiovascular or pulmonary dysfunction, alcoholism, cirrhosis or epilepsy. The heavy cigarette smoker is also a notably poor risk for the development of good function following surgery for Dupuytren's contracture.

Second, the operative procedure should be performed in an operating room with all necessary facilities and by a fully skilled surgeon. The operation should be so skillfully and swiftly executed that tourniquet time is greatly minimized. The importance of this cannot be overemphasized, for each minute of ischemia carries its hour of later tissue reac-

tivity. This is evidenced during the postoperative period by hyperemia, congestion and eventual fibrous tissue reaction. Tourniquet times which are safe for tendon surgery in the younger age groups, for example, are much too long for the relatively less vascular hands of patients with Dupuytren's contracture. Twenty-five to forty-five minutes' tourniquet time should suffice for even the most radical resection of palmar fascia by a good operator. In a survey of tourniquet times for fasciectomy in a medium-sized (368 bed) private hospital, the average for all operations was 46.7 minutes. The range was from 11 to 160 minutes in a series of thirty-eight cases. In a second series of fifteen cases at another hospital, the average tourniquet time was 81.5 minutes, or nearly twice as long. It is my clinical impression that there is a direct correlation between tourniquet time and postoperative morbidity and disability. Possession of a tourniquet, an arm board and a superficial knowledge of the technics of surgery of the hand are no substitutes for thorough knowledge and experience in this difficult field. In addition, the inefficient time-wasting surgeon should not treat patients with Dupuytren's contracture.

The third consideration for a good result is the method used for closure of the wound. Skin grafts or flaps should be avoided, as the immobilization incident to their use precludes early postoperative movement of the fingers and hand. It is better to close the wound with the fingers flexed, for if stiffening and prolonged disability occur, the fingers can have some useful grasp. Nearly every useful manual action involves the grip, pinch or fist closure, while very few necessary or useful acts require that the fingers be fully extended; hence the flexed position is less disabling.

A fourth aid to quicker return of function in the postoperative period is the use of early motion. Splints or casts should be avoided in postoperative dressings, and simple pressure dressings should leave the fingers free to move as soon as the patient is awake. A plaster splint applied to some hands during the postoperative period can result in irreversible stiffening of the entire hand.

In recent years, Luck [9] has revived interest in less radical or palliative surgical procedures for relief of Dupuytren's contracture. His revived procedure, subcutaneous fasciotomy, carries a low morbidity and fairly high recurrence rate, but in his skilled hands it gives relief with minimal trauma. The necessity for such a procedure has opened our eyes to the all too frequent unsuccessful results of radical excision and pointed out the value of simple relief of contracture by fascial band division. One need only refer to the article by Sir Astley Cooper in 1842 [2] to find a detailed description of subcutaneous fasciotomy for this condition, yet the universal use of this simple procedure produced a recurrence rate which dictated a more radical procedure. Thus the dictum of complete and radical extirpation of the palmar fascia has long become the rule in surgical practice. It has been emphasized by Bunnell's simple statement that "radical excision of all the thickened fascia is the treatment of choice" [1].

Recently, McIndoe's splendid technic of simple excision has found application in many persons with crippled hands [10]. Its straightforward approach has led to its adoption by many surgeons. I have also outlined a simple incision for wide, safe exposure which permits rapid, accurate dissection with a minimum of morbidity and a good blood supply to the palmar skin flap with attendant better wound healing.

CONCLUSIONS

Each case of Dupuytren's contracture must be considered in the light of present and probable future disability, morbidity incident to correction, and the honest acknowledgment of the judgment and skill of the individual operator. Only then can we eliminate the appalling disabilities occurring from our efforts to correct this benign and enigmatic disease.

No attempt can be made to establish authoritative rules for surgical treatment, but emphasis must be placed on an individual appraisal by the surgeon of all the facts at his disposal. He should know too that, despite his best efforts, Nature is capricious, and even in the well selected, well operated patient disappointing morbidity and disability can result. The patient should be so informed, thus sharing some of the understanding of the surgeon's problem, and interject his own wishes as an additional factor in the decision for operation. It should be noted that good judgment is based on the surgeon's knowledge, but differences of opinion are essential to the progress and development of the proper course of any surgical procedure.

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Etiology of and Mortality from Burns at a General Hospital

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BURNS continue to cost the American public a great deal of money and increase the morbidity each year. For example, 7,000 lives are lost annually from burns in the United States [1]. At the North Carolina Orthopedic Hospital in Gastronia, 457 children were admitted with burns between 1921 and 1953, and five of these patients died. The cost of treatment was $545,952 [2]. At the King County Hospital in Seattle, Washington, 527 patients with burns were admitted between 1948 and 1955. Seventy-one of these patients died. The cost of hospitalization was $235,000 in this instance, excluding the cost for visits to the outpatient clinic, readmissions, unemployment or permanent disability.

The medical literature in recent years is replete with numerous excellent articles and reviews on the treatment of burns. However, as pointed out by Bull and Fisher [3], there has been little improvement in the mortality rates since about 1947, despite the use of increased quantities of whole blood, special attention to fluid and electrolyte problems, exposure methods of care and new antibiotics.

This paper was undertaken with several questions in mind. What are the causes of burns seen in this hopsital, and are they preventable? Do our methods of therapy, which incorporate whole blood transfusions, early grafting, prevention of infections, careful fluid and electrolyte therapy, and treatment of associated disease, give results that are comparable to those of other hospitals in terms of mortality?

MATERIALS

The charts of all patients with burns (527) admitted to the King County Hospital in Seattle from 1948 to 1955, inclusive, were reviewed. Data regarding age, sex, extent of burn, cause of burn, number of days of hospitalization, mortality and cause of death were compiled as the basis for our figures and tables. The extent of the burn was recorded in terms of the per cent of the total body surface. Berkow's [4] "rule of nines" was used to estimate this percentage.

ANALYSIS OF DATA

The number of patients admitted to the King County Hospital during the years reviewed varied from forty to eighty-six per year. (Fig. 1.) An average of 69 per cent of these patients

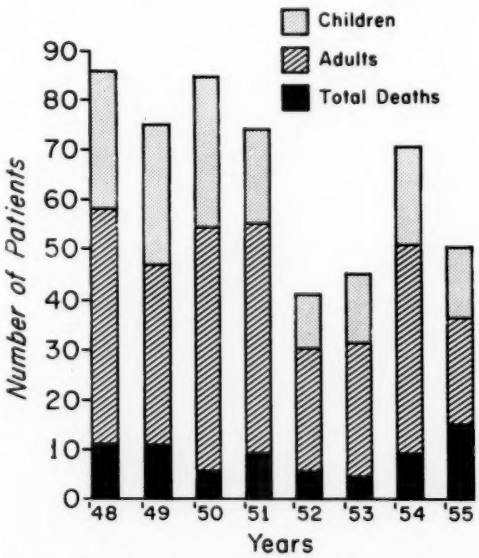

FIG. 1. Number of patients admitted each year to King County Hospital, distribution between adults and children, and total number of patients who died.

TABLE 1
CAUSES OF BURNS IN CHILDREN ADMITTED TO KING COUNTY HOSPITAL (1948–1955)

Causes	Per cent of All Burns
Spilled hot liquids	52.1
Clothing in contact with stove	14.5
Matches	7.2
Electric heater	6.1
Building or home fire	4.9
Hot stove	4.2
Inflammable liquid	3.0
Campfire	3.0
Electric toaster Automobile wreck and fire Clothes wringer Hot water bottle Chemical Firecrackers Gunpowder	0.6

were adults, and 31 per cent were children. The yearly mortality rate varied from 6 to 29 per cent.

What are the causes of burns in patients treated at this hospital, and are they preventable?

Children. A brief review of Table 1 reveals that over half the burns in children were caused by spilled hot liquids. When reading the charts of these patients one is appalled by the repetition of similar episodes, i.e., "coffee pot spilled on the child," "pulled over pan of boiling water," "turned on hot water faucet while in bath tub," or "hot soup spilled on the child." Sixty-nine per cent of these children were less than three years old. This is similar to the experience of others dealing with children's burns.

Perdrup [5] reports that 966 children with burns were admitted to the Rudolph Bergh's Hospital for Diseases of the Skin in Copenhagen, Denmark, from January 1, 1938 to May 31, 1948. Eighty-eight per cent (840) of the burns were caused by hot water or steam. Wilkinson [6], reporting from the Royal Hospital for Sick Children in Edinburgh, Scotland, where 366 children were admitted with burns from June 1, 1938 to July 31, 1942, found that 285 (77.9 per cent) were caused by spilled hot liquids. The experience of Bleck [2] is different, in that hot liquids accounted for only 8 per cent of the burns in 457 children admitted to the North Carolina Orthopedic Hospital from 1921 to 1953. However, Bleck found that ignition of clothing accounted for 45 per cent, direct contact for 24 per cent, and inflammable liquids for 15 per cent of these burns.

Since burns from hot liquids occur primarily in very young children, the responsibility for their prevention rests squarely with the parents. Wilkinson [6] points out that the children most frequently burned with hot liquids come from homes where older children are given responsibilities for infant care, the parents are working away from home and someone else assumes responsibility for the child, or in large families where the harassed mother cannot keep track of all the children all the time.

A few moments of care would prevent most of these burns. For example, the handles of cooking pans should not be left sticking over the edge of the stove where a toddler can reach them and pull them over. A child should not be left alone with bath water running as he may turn the wrong faucet off or on. When carrying a utensil which is full, heavy and hot, one should be sure that children are out of the way and that thick hot pads protect one's hands.

Another cause of burns in children is the ignition of clothing by contact with a stove, matches and electric heaters. As pointed out previously, 46 per cent of the series of burns reviewed by Bleck [2] were caused in this fashion. Somewhat over 25 per cent of children's burns treated at the King County Hospital occurred in this way. A factor that plays a role here is the composition of small children's clothing. It is usually cotton, which is just as inflammable as regenerated-type rayon. Actually, it is more inflammable since its moisture content is only 6.5 per cent, as compared with 11 per cent for rayon. This fact is pointed out and documented by Little [7], who further notes that such fabrics as wool, silk, nylon and Velon® present no flammability hazard. It is difficult to understand why the manufacturers of children's clothing do not treat cotton fabrics so that they will be flame-resistant.

It is immediately obvious that many children's burns can be prevented by greater parental care in handling potentially spillable hot liquids, and that the degree and number of burns resulting from ignition of clothing in children could be favorably reduced by the use of flame-resistant cotton clothing or clothing made from fabrics such as wool, nylon or silk.

Adults. The causes of burns in adults have a

TABLE II
CAUSES OF BURNS IN ADULTS ADMITTED TO KING COUNTY HOSPITAL (1948–1955)

Causes	Per cent of All Burns
Smoking in bed while intoxicated	20.5
Building fire	14.4
Inflammable liquids	13.8
Hot liquids	12.1
Clothing in contact with stove	10.2
Epilepsy and/or syncope	6.0
Vehicle fire	5.3
Fell or touched hot object	5.3
Matches igniting in trousers	1.1
Boat fire	1.1
Heating pad	0.8
Chemical	0.8
Suicide	0.6
Firecracker	0.3
Sunburn	0.3
Nightshirt ignited by lighting pipe	0.3
No history	7.0

greater diversity. (Table II.) The first nine categories account for 295 (81.5 per cent) burns in the adult. They can be contracted into five categories. (Table III.)

These causes are similar to those published by the Metropolitan Life Insurance Company [1], who point out that four-fifths of the deaths due to burns are incurred in or around the home. This bulletin lists the causes in the same order except for house and vehicle fires, which are not included in their list. Perdrup [5] reports that 45 per cent of burns in adults are caused by fire, 38 per cent by hot water or steam, 13.5 per cent by contact with hot objects, and the remainder by scalds due to grease. It is surprising that 20 per cent of all burns in adults were incurred by people who fell asleep in bed while smoking. Furthermore, two-thirds of these persons were acutely ethanolic.

Almost all burns in adults are preventable. If no one smoked in bed, burns in adults would be reduced by one-fifth. Inflammable liquids are required by law to be so labeled, usually with a statement in boldface type that the substance should be kept away from an open flame. Yet, most of the adults admitted with burns from inflammable liquids were trying to start a fire with it. By reading and obeying these labels on inflammable liquids, another 13 per cent of burns could be eliminated. The problem of carelessness makes the obvious ways of preventing these burns insurmountable.

TABLE III
CAUSES OF BURNS IN ADULTS

Cause	Per cent of Total Adult Burns
Smoking in bed	20.5
House or vehicle fire	19.7
Contact with a hot object	15.5
Inflammable liquids	13.8
Hot liquids	12.2

Figure 2 categorizes the various causes of death in the seventy-one patients who died. They serve to emphasize the fact that shock can still be the primary cause of death in burned patients.

Do the methods of therapy, employed at the King County Hospital (i.e., whole blood transfusions, careful fluid and electrolyte balance, early grafting, prevention of infection and treatment of associated disease), give comparable results in the terms of mortality with other hospitals?

Large series of burns in which mortality statistics are presented are not numerous. Those papers that do report mortality usually do not divide the patients into different age groups. This has made it difficult to compare adequately the statistics of King County Hospital with those of others.

One of the best documented and largest series is that reported from the Burns Research Unit, Birmingham Accident Hospital, Birmingham, England, by Bull and Fisher [3]. Their series contains 2,807 patients. In one instance they divided the patients into four age groups. Each age group was broken down into the percentage of body surface burned and the mortality was given for each percentage. In order to compare this series with theirs, the patients have been categorized in the same fashion. Their series is large, and there are many patients of each age group in each percentage of body surface burned. This series is only one-sixth as large in total numbers, but has similar numbers of patients in the two older age groups.

The mortality statistics at the King County Hospital for a given percentage of body surface burn in any one of these four age groups are graphically illustrated in Figure 3. These statistics are compared with those of Bull and

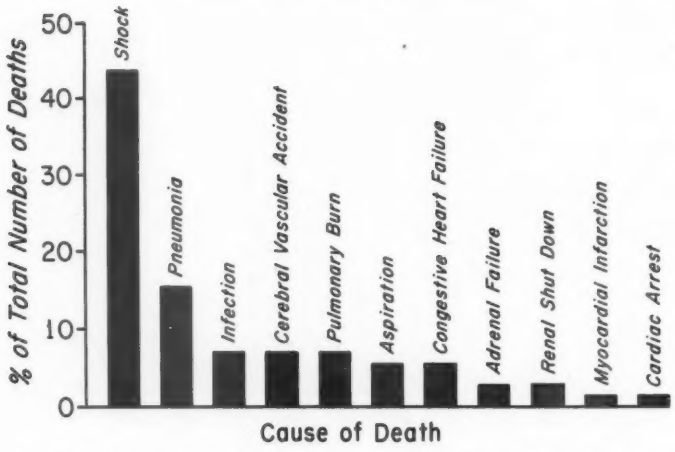

FIG. 2. Various causes of death in seventy-one patients admitted to King County Hospital and percentage who died from each cause.

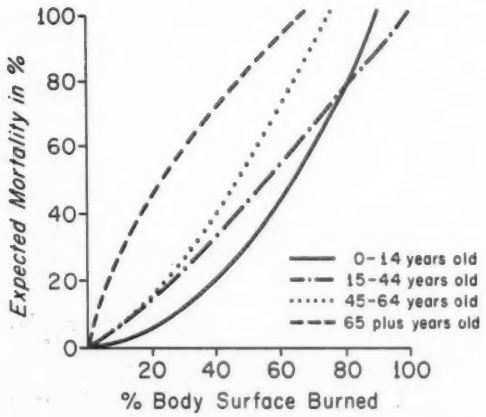

FIG. 3. Using the mortality percentage for a given percentage of body surface burned in four age groups, a curve can be calculated which will represent the expected mortality for a given age group. The four curves for the four age groups are illustrated.

TABLE IV
PER CENT MORTALITY

Body Surface Burned (%)	0–14 yr.		15–44 yr.		45–64 yr.		65 yr. and Over	
	A*	B†	A	B	A	B	A	B
0–4	0.3		3		0.8		18	10.5
5–14	0.4	1.4	1	7.2	5	5.6	41	29.5
15–24	5	5.5	6	16	19	15	80	46.5
25–34	14	11.8	0	25.2	80	27	100	61
35–44	32	20.5	11	36	75	41	100	73
45–54	44	32	62	46.5	75	56	100	85
55–64	86	45.5	100	55		74	100	95
65–74	75	61	74	67	100	91	100	100
75–84	75	81	100	78	100	100	100	100
85–94	100	100	89	100	100	100	100	100

* Mortality rates of Bull and Fisher [3].

† Expected mortality calculated on the basis of the observed mortality at King County Hospital.

Fisher [3] in Table IV. They are very similar. Their mortality is somewhat less in the younger age groups with relatively small areas of burn, while in the King County Hospital series the mortality is lower in the two older age groups with more extensive burns.

In Table V we have compared the statistics of Perdrup [5] and Lütkens [8]. Their mortality percentages are considerably higher than those of Bull and Fisher [3] or King County Hospital. This is particularly true of those of Lütkens [8], which are for patients seen during the years 1915 through 1935, when the treatment of burns did not include whole blood transfusions, fluid and electrolyte balance, and antibiotics.

Hay and Cronin [9] published mortality statistics for 505 burns treated in three hospitals in Houston, Texas, over a ten-year period. Their statistics are not comparable to ours, since they do not separate statistics for children and adults in quoting mortality for a given percentage of body surface burned. In general, the over-all mortality percentages at King

TABLE V
PER CENT MORTALITY

Body Surface Burned (%)	0–2 yr.		2–4 yr.		5–15 yr.		16–65 yr.		Over 65 yr.	
	A*	B†	A	B	A	B	A	B	A	B
0–5	0	9.3	0	2.0	0	0	0	0	0	0
6–10	8.5	25	1.8	8.2	0	9.1	0.8	1.1	16.7	75
11–20	18.8	87	23.5	42	0	0	0	42	66.7	100
21–30	100	100	50	100	0	...	36.3	100	100	100
31–40	100	100	100	100	0	...	30.7	100	100	100
41 and over	100	100	100	100	100	100	100	100	100	100

* Perdrup, Denmark, 1938–1948 [5].
† Lütkens, Denmark, 1915–1935 [8].

County Hospital are higher when the burn covers a smaller percentage of the body and lower when the burn is more extensive.

The mortality among burned children who were treated at King County Hospital is compared with other series of children with burns (Wilkinson [6], Farmer [10]) in Table VI. It is apparent that the mortality is lower in the King County Hospital series. The statistics for the other two series are drawn from patients who were treated before the present era of modern burn therapy.

At King County Hospital, patients with more than 20 per cent of the body surface burned, who are sixty-five years old or older, have only a 50 per cent chance of survival. Children survive as often, or more frequently, than adults, contrary to the commonly held opinion. Bull and Fisher [3] state that the response of patients with all sizes of burns varies little up to the age of thirty, but that from there on the prognosis worsens, so that a 7 per cent burn carries a 50 per cent mortality among patients eighty years of age or older. Our experience confirms this.

As a result of these comparisons, one can conclude that the present methods of therapy for burned patients produce, in terms of survival, results similar to those of other clinics reporting series from this present decade. They are better than the statistics reported on series of patients from past decades, when the form of treatment did not include antibiotics, whole blood, and maintaining fluid and electrolyte balance. The present methods of therapy attempt to incorporate the well founded and

TABLE VI
PER CENT MORTALITY IN CHILDREN

Body Surface Burned (%)	King County Hospital 1947–1955	Wilkinson 1938–1942	Farmer		
			1913–1924	1925–1957	1938–1941
5–10	1.4	2.5	7.7	3.4	0.8
15–20	5.5	...	38.8	30.8	3.3
25–30	11.8		67.6	66.6	33.3
35–40	20.5	13.0	68.6	63.7	66.6
45–50	32.0		100	87.5	100
55–60	45.5	55.5	...	100	...
65–70	61.0		...	...	...
80	81.0		...	...	...
90	100		...	...	...

proved methods, as outlined by such authors as Harkins [11], Griffith [12] and Roberts, Fitts and Ravdin [13].

SUMMARY

The etiology of burns as seen at the King County Hospital in Seattle, Washington, is reviewed. Children's burns are most frequently caused by spilled hot liquids, while adults are most frequently burned as a result of falling asleep while smoking in bed.

Greater parental effort to eliminate potential "hot liquid" hazards from the environment of small children would markedly reduce children's burns. The use of non-inflammable or fire-resistant materials in children's clothing would further reduce the number of burns among children. Many adult burns are easily preventable. This prevention rests with each adult.

Our mortality statistics have been presented as one criterion of the effectiveness of the

therapy consisting of whole blood transfusions, prevention of infection, early grafting, and careful fluid and electrolyte therapy. When these statistics are corrected for age, they show results in terms of survival that are comparable with those of other institutions using modern methods of therapy.

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The Problem of Endometriosis of the Colon

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ENDOMETRIOSIS constitutes a real problem which will confront the surgeon who must differentiate this lesion from cancer of the bowel. In a previous article [1] we reviewed the cases of endometriosis at the Allentown Hospital and found that of 225 patients with endometriosis, seventy-seven (34.22 per cent) showed some degree of bowel involvement.

Our total number of cases of endometrioma of the bowel is now thirteen. These are the patients particularly important to the proctologist and the general surgeon. The literature was reviewed, and since our experience is similar to others reporting large series of cases, a report on the literature was considered unnecessary at this time.

ETIOLOGY

We have nothing to offer in proof of etiology. The various theories from a review of the literature will merely be stated. Many writers believe that endometrial tissue is regurgitated through the fallopian tubes. Others think that ectopic endometrium can explain the disease. Some believe the endometrial cells migrate in the lymphatics and blood vessels.

PATHOLOGY

Ordinarily the disease originates in the uterus which is the most common site. It can spread to the ovaries and pelvic peritoneum, then to adjacent viscera such as the sigmoid, rectum, bladder, small bowel, cecum, appendix, uterine cervix, vagina and rectovaginal septum. A laporatomy scar, the umbilicus, inguinal lymph glands and mediastinal lymph glands may also be involved.

The lesions begin as red, blue or colorless nodules which increase in number and size. Reactionary fibrosis develops. Endometriosis of the bowel is divided into two types. First is the superficial puckered type involving only the serosa. Microscopically, the endometrial glands and stroma are surrounded by fibrous tissue. The second type is the dangerous, deep type which involves the muscle and eventually produces obstruction. The mucosa is not involved.

SYMPTOMS

Symptoms are usually of long duration. Menorrhagia, dysmenorrhea and dyspareunia are common. With bowel involvement, the patient may either be completely free of obstructive symptoms or complain of rectal pressure and tenesmus as well as severe constipation, especially immediately prior to and during menstruation. Sterility or relative sterility is frequent. Rectal bleeding is mentioned repeatedly in the literature as an occasional symptom, but we believe that it must be extremely rare as it was not observed in any of our cases.

DIAGNOSIS

The preoperative diagnosis of endometriosis of the colon is made rather infrequently, although such a diagnosis was made in six of our patients. One usually finds nodules in the rectovaginal septum on pelvic examination. A mass in the cul-de-sac with marked tenderness on rectal or vaginal examination is occasionally noted. On proctoscopy the rectum at the rectosigmoidal level is narrowed and angulated anteriorly due to fixation to the uterus and cervix. A submucosal mass is frequently found at this level and pressure of the proctoscope against the submucosal mass will evoke considerable pain. The bowel may be involved higher, but in all cases the mucosa is intact. A barium enema will reveal a long filling defect with an intact mucosa, in contrast to the short

filling defect and "apple core" deformity of the mucosa in carcinoma.

DIAGNOSIS AT SURGERY

This is considered under a separate heading since careful surgical judgment is so important, and a correct diagnosis must be made to prevent radical surgery from being performed for a presumptive diagnosis of carcinoma. Abdominoperineal resections have occasionally been performed for endometrioma of the colon. More frequently, proximal colostomy is needlessly performed, subjecting the patient to the additional hazards of mortality, morbidity and prolonged hospitalization. If a lesion of the bowel is discovered incidentally within reach of the sigmoidoscope at pelvic or other surgery and there is doubt as to the diagnosis, two steps may be taken to insure making a correct diagnosis. The operative field is covered with sterile drapes, the patient's legs are placed in stirrups, and immediate sigmoidoscopy is done. If the mucosa of the bowel is intact at the site of the lesion, the diagnosis of endometriosis can be confirmed. Another alternative is to place an atraumatic clamp on the bowel proximal to the lesion. This is followed by the instillation of 100 to 300 cc. of a 1 per cent solution of Neomycin® into the bowel. A waiting period of thirty minutes is allowed and during this time any other surgery that may be indicated is completed. The bowel is then opened along the antimesenteric border proximal to the tumor, and a sigmoidoscope is inserted. If the mucosa is intact, the diagnosis is confirmed and the bowel is closed. The discovery of an unsuspected lesion of the bowel in the presence of extensive pelvic endometriosis, or even in its absence, should be proved to be cancer before any operative procedure on the bowel is undertaken. We have not found frozen sections necessary or feasible in the diagnosis of endometrioma of the colon.

TREATMENT

The treatment of endometriosis of the colon falls generally into the following classifications:

Endometrioma of the Colon Early in the Childbearing Period. When the bowel is completely obstructed in a young woman, resection of the bowel and primary anastomosis should be performed in conjunction with uterine suspension when indicated and presacral neurectomy; resection of endometrial cysts of the ovary with preservation of as much ovarian tissue as possible is performed. If only partial obstruction is present due to angulation and fixation of the bowel to the uterus or cervix, the rectum and/or sigmoid colon should be completely freed from the uterus and cervix and suspended from the psoas minor tendon as in a rectal procidentia. This again is done in conjunction with uterine suspension and presacral neurectomy. Postoperatively, the patient may be given small doses of testosterone daily for several months.

Endometrioma of the Colon Late in the Childbearing Period. The problem is simpler in this category. Panhysterectomy is performed as the only definitive procedure. The adnexa and involved bowel are left alone. Beecham [2] has stated that surgical amenorrhea results in rapid resolution of the endometrial implants, and he reports one case in which a constricting endometrioma of the colon disappeared almost completely when this procedure was used. In the rare case in which this does not suffice, x-ray therapy for castration can then be performed.

Endometrioma of the Colon in Menopausal and Postmenopausal Women. Panhysterectomy and bilateral salpingo-oophorectomy are performed. No surgery is indicated for endometrioma of the bowel.

CONCLUSIONS

Endometrioma of the colon can be a perplexing problem and calls for skillful management. The preoperative diagnosis can occasionally be made when the patient presents with the symptoms of dysmenorrhea, dyspareunia and menorrhagia in conjunction with severe constipation especially prior to and during menstruation. On proctoscopic examination one occasionally notes marked tenderness on pressure at this point. An unsuspected lesion of the sigmoid or rectum in a woman should be proved to be carcinoma and not an endometrioma by immediate sigmoidoscopy or colonoscopy at the table before any definitive surgery on the bowel is undertaken.

Treatment for women in the early childbearing period consists of resection of the bowel and anastomosis if the lesion is completely obstructing, or mobilization and suspension of the rectum in case of incomplete obstruction due to angulation. Uterine suspension, presacral neurectomy and resection of ovarian endometrial

implants are also performed. In the late childbearing period, panhysterectomy without surgery on the adnexa or bowel will result in rapid resolution of any obstructive bowel symptoms. For the menopausal and postmenopausal women, panhysterectomy combined with bilateral salpingo-oophorectomy is indicated. Surgical amenorrhea, whether by hysterectomy and/or bilateral oophorectomy is sufficient to control obstructing bowel symptoms resulting from endometrioma of the colon.

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The Deposition and Retention of Tetracycline in Cancer

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THE fluorescence of tetracycline-laden tumor tissue under ultraviolet light was first reported in 1957 by Rall and associates [1], at the National Cancer Institute. Their initial observation was made while exposing to ultraviolet light the autopsy specimen from a tetracycline-treated patient with breast cancer. The tumor tissue manifested a yellow fluorescence, as compared with the surrounding normal tissue which was autofluorescent and gave only a bluish direct reflection of the ultraviolet light.

Investigating this phenomenon further, these workers demonstrated the appearance and persistence of fluorescent material in fourteen of nineteen different experimental neoplasms in mice, following the administration of tetracycline. They noted that all three of the tetracycline antibiotics were qualitatively similar in causing fluorescence in thirty-seven sarcomas, and found that bone and tumor tissue retained this fluoresecence in essentially undiminished intensity, for as long as twenty days. They also observed that the fluorescence was distributed diffusely in the more peripheral areas of the tumor, and was not apparent in the grossly hemorrhagic or necrotic zones.

McLeay [2] reported yellow fluorescence in eleven terramycin-prepared patients with cancer. He employed terramycin orally and intravenously in amounts which provided a blood level of 5 μg./ml. or higher for four days prior to surgery.

MATERIALS AND METHODS

Our observations of fluorescence of tetracycline in tumors are based on specimens from controls and tetracycline-prepared patients, exposed to ultraviolet light during and immediately after surgery. Similar observations were also made on fresh autopsy specimens from tetracycline-treated patients with cancer in the terminal stage of the disease. All specimens were temporarily immersed in normal saline solution or distilled water until the presence or absence of fluorescence under ultraviolet light could be determined, since tumors in formalin lose their property of fluorescence.

Achromycin®* was the source of tetracycline. It was administered orally, intramuscularly, intravenously, or by a combination of these routes. Its administration was usually discontinued forty-eight to seventy-two hours before surgery, to permit the normal soft tissues of the body to extrude or eliminate the tetracycline. In some cases, however, the total dosage of tetracycline given and the time interval (i.e., between the last dose and the date of surgery) were varied in order to evaluate the effect of dosage and time on the quality and intensity of tumor fluorescence.

The source of the ultraviolet light employed was a 9 watt, 3,660 Angstrom unit mineralight, held 6 to 8 inches from the specimen under examination.

No determinations were made of the blood levels of tetracycline obtained in these cases, but comparative determinations of the amount of tetracycline deposited in the various tumors

* Achromycin, brand of tetracycline HCl, was supplied by Lederle Laboratories Division, American Cyanamid Company, New York, New York.

were undertaken later in this study, after the development by one of us (Rhoads) of a method for semi-quantitative extraction of the drug from tumor tissue [3].

RESULTS

No benign pathologic condition has fluoresced. We have observed the phenomenon of fluorescence to be confined specifically to lesions having histologic evidence of malignancy.

Benign tumors and inflammatory lesions from patients receiving tetracycline showed only autofluorescence. These lesions included fibroadenomas, cystic disease and ductal hyperplasia of the breast; thyroid adenomata; a mixed tumor of the parotid gland (without histologic evidence of malignant change); duodenal and benign gastric ulcers; benign rectal polyps; diverticulitis of the sigmoid; villous adenoma of the rectum; and hemorrhoids.

Numerous specimens of fresh normal tissue from tetracycline-prepared patients, as well as carcinoma specimens without tetracycline, showed only autofluorescence.

No attempt was made to quantify the varying degrees of fluorescence observed in malignant tumors, but a gross visual impression of the intensity of fluorescence was noted as: none, questionable, weak, moderate, or strong. (Table 1.)

Variation in the dosage of tetracycline administered appeared to affect the resulting fluorescence in a qualitative manner, as well as quantitatively. For example, tumors prepared with small doses of tetracycline were either negative for fluorescence, or manifested a bluish gray fluorescence under ultraviolet light, which was distinctly different from the autofluorescence observed in the surrounding normal tissues. Still larger doses of tetracycline provided a bright yellow fluorescence; whereas, tumors prepared on relatively heavy doses of the drug showed a deep yellow-orange fluorescence of much greater intensity. Our gross visual impressions concerning the variation in intensity and quality of fluorescence obtained with varying dosage of the drug, was substantiated in some cases when semi-quantitative extraction of tetracycline from the tumor tissue revealed greater concentrations of that substance in tumors possessing stronger fluorescence. (Table 1.) These observations suggest the total concentration of fluorophor deposited in tumor tissue to be a direct function of tetracycline dosage.

It is our impression that, in general, highly anaplastic tumors had a greater avidity for tetracycline than did those which were well differentiated, and hence fluoresced more strongly.

Tumors containing zones of necrosis or abscess cavities did not manifest fluorescence in these areas; presumably, this resulted from a poor blood supply. In general, the strongest intensities of fluorescence are to be noted in those portions of the tumor which are undergoing the greatest cellular activity and the most active growth.

There appears to be a definite variation in the avidity or binding-capacity of the various histologic types of malignant tumors for tetracycline. For example, on a comparable dosage of tetracycline, reticulum cell sarcomas have been observed to fluoresce more intensely and give a higher analytic yield of the fluorophor than adenocarcinoma; whereas, comparable doses seemed to provide more deposition of the fluorophor in adenocarcinomas than in squamous cell carcinomas. Further studies will be necessary to clarify this observation.

A thorough evaluation of fluorescence in regional lymphatics and metastatic lesions was not undertaken in the present study. However, fluorescence was observed in several metastatic lesions. In a case of epidermoid carcinoma of the parotid gland (Table 1, Case 32), a regional lymph node containing metastasis fluoresced. A large metastatic tumor of the liver from a primary adenocarcinoma in the colon (Case 4) fluoresced strongly, whereas, the normal liver parenchyma surrounding this lesion showed only autofluorescence. A large metastatic squamous cell carcinoma in the lateral cervical region, in which the primary lesion was located in the gingival mucosa (Case 29) showed spotty yellow fluorescence. A liberal biopsy of a metastasis to the chest wall from an osteogenic sarcoma in the lower third of the femur gave a strong bluish fluorescence under ultraviolet light. Biopsies of peritoneal implants from a case of inoperable adenocarcinoma of the stomach (linitus plastica, Case 20) fluoresced. Exposure of the contents of the abdominal cavity to ultraviolet light during laparotomy in this case revealed numerous yellow fluorescent spots corresponding to peritoneal, omental and visceral implants.

TABLE I

TUMOR FLUORESCENCE*

Case No. and Patient	Age (yr.), Sex	Date of Examination for Fluorescence (Surgical or autopsy material)	Diagnosis	Total Dose of Achromycin Received	Time Interval Between Last Dose and Time of Surgery or Autopsy (hr.)	Fluorescence	Tumor Content of Achromycin (mg./gm. of tissue)
1. A-61665, G.H.	67, M	2/21/58	Adenocarcinoma of colon	2.5 gm. (oral)	48	Bluish (questionable)	No analysis
2. 160323, J.R.	60, M	8/18/58	Adenocarcinoma of right colon	3.0 gm. (oral)	48	Bluish (moderate)	0.3 mg./gm.
3. O.J.	49, F	8/28/58	Adenocarcinoma of sigmoid colon	4 gm. (oral)	60	Spotty yellow (moderate)	7.3 mg./gm.
4. A-65995, F.T.	53, F	10/16/58 (Autopsy; liver metastasis from colon resection one year previously)	Adenocarcinoma of colon metastatic to liver	48 gm. (oral) 1.2 gm. (intravenous	7 da.	Yellow-orange (very strong); normal liver did not fluoresce	No analysis
5. A-77401, H.P.	68, F	10/29/58	Adenocarcinoma of cecum	5 gm. (oral) 4 gm. (intravenous)	48	Spotty yellow (moderate)	No analysis
6. 445, T.B.	73, M	11/4/58	Adenocarcinoma of right colon	5.5 gm. (oral) 1.6 gm. (intramuscular)	6 da.	Yellow (strong)	7.2 mg./gm.
7. A-76899, J.B.	73, M	11/17/58	Adenocarcinoma of right colon	6.0 gm. (oral)	No time lag	Yellow (slight)	0.4 mg./gm.
8. A-78951, J.T.	62, M	1/14/59	Adenocarcinoma of colon	2.75 gm. (oral)	24	Spotty yellow (weak)	0.2 mg./gm.
9. A-59596, A.E.	74, F	4/10/59	Adenocarcinoma of right colon	6 gm. (oral)	12	Spotty yellow (moderate)	4.8 mg./gm.
10. 4840, C.B.	70, F	4/29/59	Adenocarcinoma of right colon	6 gm. (oral)	24	Spotty yellow (strong)	5.4 mg./gm.
11. A-71083, J.B.	70, M	4/4/58	Adenocarcinoma of rectum	3.5 gm. (oral) 1.5 gm. (intramuscular)	48	Bluish (strong)	No analysis
12. A-27033, A.D.	75, M	4/5/58	Adenocarcinoma of rectum	4 gm. (oral) 400 mg. (intramuscular)	72	Blue (poor)	No analysis
13. 144790, M.V.	50, F	4/21/59	Adenocarcinoma of rectum	3 gm. (oral) 3 gm. (intravenous)	12	Spotty yellow (questionable)	0.5 mg./gm.
14. A-83673, R.G.	79, M	6/8/59	Adenocarcinoma of rectum	4 gm. (oral)	12	Spotty yellow (weak)	No analysis
15. A-72080, S.B.	66, F	4/22/58	Adenocarcinoma of breast (scirrhous)	2.75 gm. (oral)	48	Bluish (weak)	No analysis
16. A-68704, M.V.	52, F	8/25/58	Ductal carcinoma of breast	3 gm. (oral)	48	Yellow (strong)	2.8 mg./gm.
17. A-77361, S.M.	65, F	10/28/58	Ductal carcinoma of breast	9 gm. (intravenous)	12	Yellow (moderate)	0.1 mg./gm.
18. A-79690, N.R.	43, F	1/9/59	Adenocarcinoma (ductal) of breast	1 gm. (intravenous)	6	Yellow (questionable)	0.4 mg./gm.
19. A-22229, L.V.	37, F	2/25/58	Adenocarcinoma of stomach (linitus plastica)	500 mg. (intravenous)	24	None	No analysis
20. A-55854, D.McG.	77, F	8/19/58	Adenocarcinoma of stomach (linitus plastica); biopsy of peritoneal implant	3 gm. (oral) 1 gm. (intravenous)	48	Yellow (strong)	No analysis
21. A-7759, L.H.	81, M	3/25/59	Adenocarcinoma of stomach	1 gm. (intravenous)	12	None	0.03 mg./gm.
22. A-81605, F.M.	84, M	3/31/59	Adenocarcinoma of stomach	500 mg. (intravenous)	12	None	0.6 mg./gm.
23. A-82695, C.H.	51, M	5/19/59	Adenocarcinoma of stomach	5 gm. (oral)	12	Yellow (weak)	No analysis
24. A-79089, I.J.	37, F	12/19/58	Reticulum cell sarcoma of stomach	500 mg. (intravenous) 2.5 gm. (oral)	12	Spotty yellow (moderate)	3.5 mg./gm.
25. A-80211, L.B.	68, M	2/2/59	Reticulum cell sarcoma of stomach	3.5 gm. (oral)	24	Yellow-orange (strong)	0.2 mg./gm.
26. W.Y.H.	54, M	July 1958	Hepatoma	3 gm. (oral)	48	Yellow (moderate to strong)	0.3 mg./gm.
27. A-51740, P.V.	30, M	4/11/58	Osteogenic sarcoma of the lower third of the right femur; metastasis to chest wall	4 gm. (oral)	48	Bluish (strong); biopsy of chest wall metastasis)	No analysis

* As indicated above, tumors from patients receiving small doses of Achromycin did not fluoresce; whereas, histologically similar lesions associated with larger doses of the antibiotic fluoresced.

TABLE 1 (*Continued*)
TUMOR FLUORESCENCE

Case No. and Patient	Age (yr.), Sex	Date of Examination for Fluorescence (Surgical or autopsy material)	Diagnosis	Total Dose of Achromycin Received	Time Interval Between Last Dose and Time of Surgery or Autopsy (hr.)	Fluorescence	Tumor Content of Achromycin (mg./gm. of tissue)
28. J.B.	M	July 1958	Squamous cell carcinoma of lip	3 gm. (oral)	24	Spotty yellow (weak)	0.3 mg./gm.
29. A-77522, A.C.	70, M	10/30/58	Squamous cell carcinoma Metastatic to neck from mouth (gingiva excised 1 year previously)	3 gm. (oral) 1.5 gm. (intravenous)	4 da.	Yellow (moderate)	No analysis
30. P.D.	M	July 1958	Squamous cell—tonsil carcinoma	3 gm. (oral)	48	Yellow (moderate)	0.7 mg./gm.
31. 137704, J.N.	47, M	7/2/58	Squamous cell carcinoma metastatic to neck (primary undisclosed)	3 gm. (oral)	24	None	No analysis
32. A-76573, W.T.	70, M	9/19/58	Epidermoid carcinoma of parotid	4 gm. (oral) 2 gm. (intravenous)	4 da.	Tumor (yellow, moderate); metastatic lymph node (yellow, poor)	No analysis
33. A-83282, C.W.	65, M	6/9/59	Squamous cell carcinoma of tongue	4 gm. (oral) 3 gm. (intravenous)	48	Spotty yellow (strong)	7.6 mg./gm.
34. 134429, D.C.	40, M	2/7/58	Transitional cell carcinoma of renal pelvis	4 gm. (oral)	12	None	No analysis
35. 4230, J.L.	54, M	4/1/59	Papillary transitional cell carcinoma of kidney	1.25 gm. (oral)	12	None	No content on analysis

On various occasions we have attempted to evaluate the use of ultraviolet light at the operating table, as a means of supplementing or enhancing the surgeon's visual and tactile abilities of localizing primary and metastatic deposits of cancer. We are satisfied that the phenomenon of tetracycline-cancer fluorescence, *per se*, is not a dependable modality for this purpose. The interposition of even relatively thin layers of normal tissue between an otherwise fluorescent tumor and the source of ultraviolet light, serves to nullify efforts in localizing a tumor by this method.

COMMENTS

Employing fluorescent microscopy, Bottiger [4] demonstrated the accumulation of tetracycline in the reticuloendothelial system and the excretory organs (liver, kidneys and intestine). The depth of yellow fluorescence in the tetracycline-laden tissue varied somewhat with the dosage and the route of administration. The fluorescence disappeared most usually within forty-eight hours after administration of the antibiotic, and was always absent after seventy-two hours.

Milch and co-workers [5,6] have demonstrated the deposition and retention of tetracyclines in bone. They noted fluorescence of bone to persist in rabbits for as long as six months after a single parenteral dose of the drug. These investigators suggest that fluorescence of bone is due to a complex interfacial interaction which involves the four-ringed naphthacenecarboxamide nucleus of the tetracycline, calcium and a butanol-extractable peptide fraction in bone. It would appear that the fluorophor bears an independent relationship to the bacteriostatic effect of tetracycline, since Anderson et al. [7] have shown that the antibiotic properties of bone-deposited tetracycline are lost after only ninety-six hours.

The exact nature of the retention of the tetracyclines by cancer tissue is not yet understood. Titus et al. [8] have suggested that the fluorophor probably represents tetracycline bound to a peptide in the tumor tissue. Whatever the mechanism responsible for this phenomenon is, it is evident that the exact conditions governing its appearance in cancer tissue are not present in benign tumors, normal soft tissues, or inflammatory tissues.

The diagnostic and therapeutic implications underlying the tetracycline-binding ability of cancer tissue and bone are evident. In view of the specificity of the phenomenon of tetracycline-cancer deposition, there is a possibility that further chemical refinements of the tetracycline molecule may provide a means of discovery and localization of otherwise occult deposits of malignant tissue. For example, should radiotracer-tagged tetracycline prove to manifest this same specificity of deposition, the use of appropriate scintillographic or counter equipment could prove fruitful on the clinical level as well as at the operating table. We are now investigating the diagnostic possibilities of radioiodinated tetracycline compounds in tumors in animals.

Recently, two of us (Cobb and Rhoads) have succeeded in conjugating a boronated tetracycline compound (tetracycline boronic acid, unpublished work), which is being evaluated in tumors in animals from the standpoint of ultimate neutron-capture therapy. Preliminary observations indicate that the administration of this compound permits deposition of fissionable material (boron) in cancer tissue. The results of neutron-beam exposure of such tumor preparations will be the subject of a subsequent report.

CONCLUSIONS

1. Fluorescence is reported in thirty-five patients with cancer receiving tetracycline. This phenomenon has been observed to be confined specifically to lesions having histologic evidence of malignancy. No benign tumor or inflammatory pathologic condition has fluoresced.

2. Semi-quantitative extraction of tetracycline from malignant tumors, as well as gross visual observation of tumor fluorescence, indicate the concentration of fluorophor deposited in cancer tissue to be a direct function of tetracycline dosage.

3. A definite variation in the avidity or tetracycline-binding capacity of the various histologic types of malignant tumors has been observed.

4. The diagnostic and therapeutic possibilities relating to the specificity of the tetracycline-cancer binding phenomenon are being investigated.

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Use of Teflon in Replacement of Aortic and Arterial Segments

EXPERIMENTAL AND CLINICAL RESULTS COMPARED WITH HOMOGRAFTS AND OTHER MATERIALS

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AORTIC and arterial replacements for aneurysmal and selected patients with occlusive disease now are accepted procedures in hospitals where cardiovascular surgery is in use. This type of surgery is not new. Its general surgical application, however, is recent. Certain contraindications to this therapy exist. If the limitations of these dictates are followed, reasonably good results can be expected. Somewhat in order of importance, a successful vessel graft depends on (1) the absence of advanced disease or degeneration of other organs precluding any type of surgery; (2) an adequate blood flow proximal to the disease and, more important, a distal open vessel which can carry away the blood brought by the graft without clotting, the so-called adequate "run-off"; and (3) the sound surgical judgment necessary to make the decision to graft or not to graft which is of utmost importance since the technical suturing of the graft is not difficult.

Aortograms and arteriograms will eliminate some patients at once from consideration as candidates for a graft. In others, angiology may show a ribbon of dye which requires exploration of the vessels prior to making a decision to graft or not to graft. Roentgenograms are not necessary and are often contraindicated in palpable aneurysms [6].

EXPERIMENTAL WORK

Operations were performed on the aortas of 196 dogs, with 111 long term survivors. We first tried to use the animal's tissue as a blood vessel. Autogenous grafts were inserted using skin, bowel, rectus fascia (with and without peritoneal lining) and veins. (Fig. 1.) Except for the latter, the results were poor, accounting for most of the immediate postoperative deaths, and even the use of veins caused dilation or clotting in nearly 50 per cent of the animals. Homologous grafts functioned well in 85 per cent of the dogs' aortas, and in all except two which survived the operation.

PROSTHETICS

A prosthetic graft must withstand temperature changes and stress but, most important,

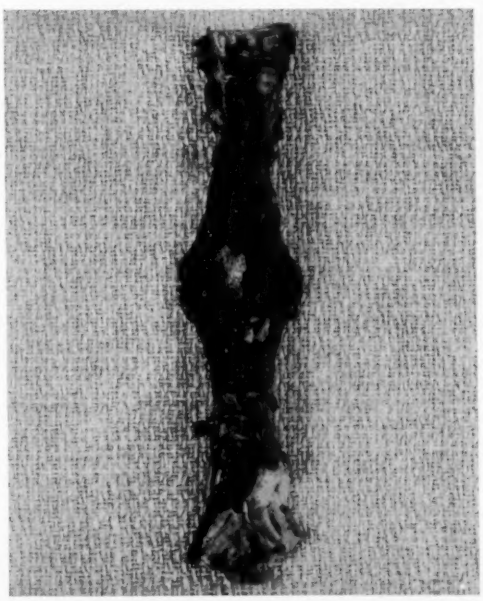

FIG. 1. Experimental autograft using skin with occlusion.

chemical changes indefinitely. It should have a low incidence of clotting and, finally, a thin, fibrous enclosure. The prosthetics tested were Ivalon® sponge, with which clotting occurred in two of every three dogs; vignon N, which bled greatly; as well as crimped nylon and crimped Dacron,® both of which were as satisfactory as homografts. Only figures on Ivalon, nylon and Teflon® are shown.

TEFLON TETRAFLUOROETHYLENE FIBER

Teflon is an inert, tough, non-friction substance. Preparation into its fiber from a resin state was a difficult manufacturing problem. It is used commercially in areas exposed to heat and corrosive chemicals such as in gaskets, heating coils, valve packings and as a filtration media. The molecular structure of Teflon consists of long carbon chains which are electrically neutral, unlike nylon and other cellulosic fibers which have strong polar forces. The regularity and close packing of the carbon chains permits strong intermolecular attraction. Fluorine completely saturates the carbon and the carbon-to-fluorine bonds make it stable to heat, stress and, especially, chemicals. Teflon's natural brown color is bleached white by chemicals. It can be swallowed by animals in reasonable amounts and has no skin irritant effects. It dissolves only if exposed to perfluorinated organic liquids at temperatures above 570°F. and then only slowly until it loses form at 621°F. It has useful strength at 400°F.; at 554°F. it begins to decompose at 2/10,000 per cent per hour or 2 parts per million per hour. It withstands exposure to concentrated nitric acid at 212°F., concentrated sulfuric acid at 554°F., and 50 per cent sodium hydroxide at 212°F. It has a chemical inertness, is moisture- and friction-resistant and has a non-adherent surface. It tolerates cold to −100°F. It was introduced by Edwards as a crimped blood vessel graft after a great deal of technical work concerning its manufacture and its crimping quality.

ADVANTAGES OF TEFLON

The ideal blood vessel graft must have a low rate of thrombosis. Fibrin quickly lines such a graft. A thin lining means less restriction of the lumen. In Teflon grafts, the fibrin is usually less than 1 mm., as Harrison [2,3] reported and I observed. Nylon and Dacron have a 2 to 3 mm. layer of fibrin. The fibrin then is replaced by fibrous tissue growing through the interstices of the graft. The less the reaction to the graft, the less the fibrosis. Teflon's inertness and the body's lack of reaction to it make it ideal in this respect.

The fibrous tissue alone, which grows into and around a graft, cannot prevent rupture or aneurysm if the fabric structure gives way. Teflon's strength (32,400 pounds per square inch at 100°F.) becomes important (Instron tensile tester). Harrison's work indicated that nylon vessel grafts lose 83 per cent of their original strength at 140 days. Dacron loses from 17 to 38 per cent of its strength; it is attacked by alkali. Studies of Teflon indicated a maximum loss of 3 per cent to a gain of 5 per cent in approximately comparable postoperative days. The crimps not only allow bending but also permit expansile pulsations similar to those in a natural artery. Nineteen of our twenty crimped Teflon grafts functioned well as aortic replacements in dogs we sacrificed at from seven to one hundred and twenty days [7,9].

INDICATIONS FOR GRAFTING

Grafts are most often placed for segmental occlusive arterial disease, aneurysms, trauma or embolic disease. The latter, except in patients under thirty years of age, is often complicated by sclerotic changes, and these may also be encountered in patients as young as ten years of age. In the transition from experimental to clinical vessel grafts, the diseased status of the blood vessels, except in the young patient or one with traumatic problems, must be kept in mind.

SURGICAL SYMPATHECTOMY

Vessel grafting merely relieves an occlusion [3,4]. Partial encroachment of the lumen by plaques sets up a stimulus to arterial spasm which at times may end in thrombosis. It has been my experience that sympathectomy is an additional safeguard and a correlative procedure for grafting in patients with segmental occlusion. Also, if grafting is found impracticable, the patient at least has the benefit of this procedure. I have yet to see a patient whose arterial supply was made worse by sympathectomy or the so-called "paradoxic effect" of sympathectomy. However, I have seen patients who were not improved by sympathectomy,

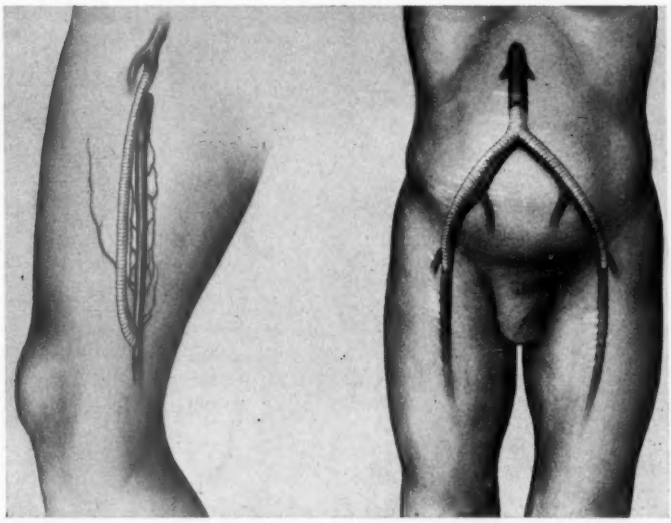

FIG. 2. Teflon prosthetic graft. *Left*, end-to-end proximal, end-to-side distal femoral artery. *Right*, aortic bifurcation to femoral arteries; end-to-end or end-to side proximal, end-to-side distal.

which I think is due to too late or too little sympathetic denervation [*5,10*].

TECHNIC FOR ABDOMINAL AORTIC GRAFT

A long midline abdominal incision is used with the patient under continuous spinal anesthesia; this is selected for its vasorelaxing effect on the renal arteries. Hypothermia is no longer used [*11*]. The retroperitoneum is incised, and the anterior and posterior peritoneum are united by continuous suture to keep the bowel out of the operative field [*8*]. In occlusive arterial disease, the decision to graft is made by opening the vessel below the block and determining the adequacy of the "run-off." In 40 per cent of my operations (eighty of 200), I have decided not to place a graft at this stage. (Fig. 2.) All efforts are made to resect these tumors in aneurysmal disease since the prognosis is nil otherwise. From the technical standpoint, resection of the arteries below the occlusion or aneurysm and then lifting the aorta up has permitted better mobilization. If the iliac veins and vena cava are adherent, a piece of the aorta is left attached to the large veins since no cleavage line exists between the two types of vessels. Heparin (10 mg. in 30 cc. of diluent) is injected into the proximal and distal vessels before they are occluded. The aorta is then sutured to the graft with a double-ended swedged needle. (Fig. 3.) The difficulties of matching an enlarged recipient aorta with a smaller sized graft are known to all who do this surgery. The same problem exists distally. In some instances of obliterative disease, I have inserted end-to-side grafts proximally as well as distally. Each case poses its own problems. Endarterectomy is performed before grafting and usually is a preliminary part of each operation. (Fig. 4.) Self-flushing of the graft with blood is performed. One leg of the graft is attached to the iliac or femoral artery distally and flushing of the anastomosis by blood is again permitted. This blood must be aspirated from the graft, and this maneuver should be performed again just before the final anastomotic sutures are placed [*7*].

TECHNIC FOR ILIAC AND FEMORAL GRAFT

When the iliac artery is occluded at the bifurcation of the aorta, an open run-off vessel is first exposed. Endarterectomy is performed on the iliac artery until an adequate flow of blood is obtained from the aorta through the iliac stump without occluding the aorta. The graft is placed end-to-end proximally and passed retroperitoneally to the distal site where it is sutured in an end-to-side manner.

The same technic is used for the femoral artery. (Fig. 5.) If most of the femoral artery is

FIG. 3. Photograph of operation showing aortic-to-femoral grafts in place.

FIG. 4. Aneurysm of abdominal aorta, resected and grafted.

blocked, the proximal end of the graft is placed at the femoral artery after endarterectomy to obtain a good flow just below its bifurcation. If this artery is not blocked completely the anastomosis is performed in an end-to-side fashion. All the end-to-side grafts are of the "onlay" type, that is, with the upper and lower ends of the graft attached to the artery wall above and below but not to the lumen [7,9]. The sides of the anastomosis are attached directly to the lumen. No window is cut in the artery, the graft holding the artery incision open. The recipient artery incision is measured to the exact size of the graft. In general I use ¼ inch grafts for the femoral artery, ⅜ to ⅝ inch for the iliac artery, and any size necessary

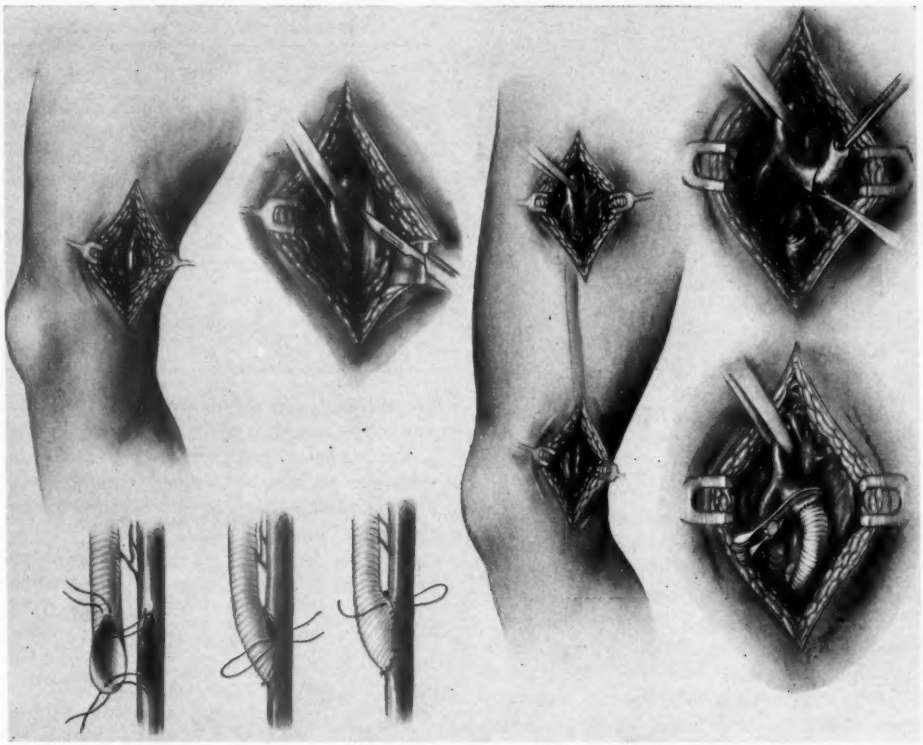

FIG. 5. Endarterectomy and Teflon graft. Obstructed stump used for proximal end-to-end anastomosis. Note technic of end-to-side onlay graft.

for the aorta. Until recently I have used No. 3-0 silk for the aorta, No. 4-0 for the iliac artery and No. 5-0 for the femoral artery. Of late I have replaced the silk with a fine steel wire (No. 38 calibre), which corresponds in size to a No. 8-0 silk and has the important advantage of also being inert and causing no tissue reaction. All patients are heparinized (locally and generally) at the time of operation, and oral anticoagulants are prescribed thereafter, keeping the prothrombin time between twenty and thirty seconds. Many of my patients are kept on anticoagulant therapy for their lifetime. I have sixty to 100 patients on anticoagulant therapy on an ambulatory basis at the present time.

CASE REPORT

In February 1956, signs and symptoms of occlusion developed in the left leg of this patient (a white American man, now fifty-four years of age). A large femoral-popliteal aneurysm in the left leg was found and excised. An end-to-end crimped nylon graft was inserted with a return of the oscillometric readings which now equal the other (normal) extremity.

In February 1958, the patient had sudden acute pain, coldness and paralysis in the right arm without pulsations. Shortly thereafter a mass developed on the right side of the neck, above and below the clavicle. This aneurysm, beginning at the innominate artery, was resected after removing the clavicle, and an end-to-end Teflon graft, 5/8 inch in diameter, was inserted from the innominate to the brachial artery with return of all the pulses and oscillometric readings.

This patient is of interest not only because he has had an aneurysm at two extremities which was successfully treated, but also because two different types of prostheses have been inserted, both of which are functioning—one four years and one more than two years since insertion.

RESULTS

Of the twenty-six vein grafts which were inserted, only two are known to be functioning.

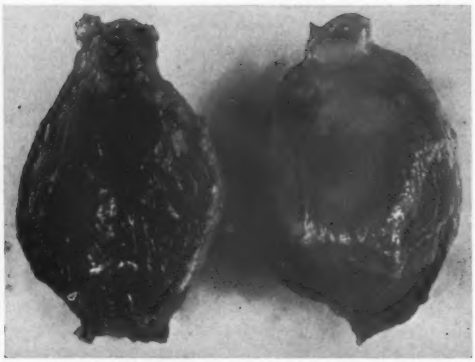

FIG. 6. Aneurysm of subclavian artery by innominate artery. Loss of pulse. Resected fourteen months ago with insertion of Teflon graft, 5/8 inch in diameter, end-to-end. All pulses returned.

Two legs were lost in this group, but in the others the veins functioned at least until collaterals developed. Seventeen homografts were used. No homografts have been inserted since May 1956, due in part to the difficulty in obtaining them, storage, their tendency to sclerosis and their occasional foreign body action. One of my grafts sloughed out. Various prosthetics were then employed, especially crimped nylon. Since January 1958, all grafts have been of Teflon. (Fig. 6.) Twenty-three of these have been placed long enough to determine their results. Since the woven Teflon graft has been available, I have not used the knitted ones because, like crimped nylon and Dacron, these weep and bleed through the apertures. The patients lost between 750 and 1,500 cc. of blood with these grafts. Placement of a rubber tissue drain over the graft which could be tied loosely at either end to the graft and recipient ends helped in preventing this blood loss, since once the drain was filled it counterdammed the blood leak when the clamps were removed. After five minutes this drain could be cut and discarded.

Postoperative results require classification. It is obvious that if the patient survives, does not lose an extremity and all the pulses return, the results are perfect. If the patient does not survive or loses an extremity, the result is a failure. On the basis of the return pulses, the figures in all clinical grafts are shown in Table I. Only one extremity was lost.

A second group of patients survive, do not lose their extremities and are clinically improved, but their pulses are not restored. This is due to the fact that while the major obstruction is overcome, other partial or incomplete occlusions are present or develop inherently in the disease. On the basis of clinical improvements, the results are shown in Table II.

TABLE I
RESULTS BASED ON RETURN PULSES

Site of Graft	No. of Patients	Return Pulses	
		No.	Per cent
Aorta	28	19	67
Iliac artery	29	18	62
Femoral artery	67	41	61
Innominate artery	1	1	100
Subclavian artery	1	1	100
Total	126	80	63

My results after aortic replacements in aneurysms do not please me. Many of these patients reach me after the aneurysms have ruptured or dissected. Some are not resectable. In eight such patients, I have reverted to wiring. Only one of these died immediately after operation. Five are alive after more than two years. This treatment remains a good one in the patients with rupture and adhesions of the bowel which prove technically non-operable. I have performed only four aortic replacements with Teflon—all in patieuts with advanced aneurysms.

Table III shows the results with Teflon compared to other types of grafts. These latter better results must be attributed in part to improved selection of patients, but I believe

TABLE II
RESULTS BASED ON CLINICAL IMPROVEMENT

Site of Graft	No. of Patients	Clinical Success	
		No.	Per cent
Aorta	28	19	68
Iliac artery	29	27	93
Femoral artery	67	60	90
Innominate artery	1	1	100
Subclavian artery	1	1	100
Total	126	108	87

TABLE III
RESULTS WITH TEFLON COMPARED TO OTHER TYPES OF GRAFTS

Site of Graft	No. of Patients	Pulse Returns		Clinical Success	
		No.	Per cent	No.	Per cent
Other Types of Grafts					
Aorta	22	15	6	15	68
Iliac artery	26	15	58	24	92
Femoral artery	50	24	48	43	86
Total	98	54	55	82	84
Teflon Grafts					
Aorta	6	4	66.66	4	66.66
Iliac artery	3	3	100	3	100
Femoral artery	18	18	100	18	100
Innominate artery	1	1	100	1	100
Subclavian artery	1	1	100	1	100
Total	29	27	93	27	93

the Teflon graft material, itself, has played a part.

My first purpose in presenting this paper was to indicate that I believe prosthetics are better for replacement grafts than homografts or veins, and that, of these, Teflon seems to be the best available substance. There is a second purpose in presenting this paper which, I think, is even more important. Many physicians believe that grafting procedures for aneurysmal and occlusive disease are simple and nearly always successful. Some clinics have reported such results, and these figures have been accepted as usual or expected results. My experience does not bear out that such a percentage of success with grafts will be obtained routinely unless there is careful selection of patients. I have been suturing blood vessels for a long time. Some restraint as to the immediate effects to be expected of graft replacements, especially in the aorta, is necessary. The disease in my patients may be more advanced than it is in patients in some other clinics. Results of blood vessel grafts in this part of the country differ from other sections.

SUMMARY

A series of patients operated upon for occlusive and aneurysmal disease with replacement by a Teflon prosthetic graft is presented.

Experimental work on various substances used as grafts is included, giving the advantages of prosthetics, especially Teflon, over homografts or autografts.

The importance of knowing when not to graft is emphasized. Percentages of success, while not equal to some clinics' reports, indicate that in selected patients good results can be expected.

In the patients with extensive disease seen in our clinic, better results probably could not be obtained unless many who need the operation are refused surgical treatment.

A case report is presented of a patient with an aneurysm of a major artery in the leg, neck and arm which was successfully treated.

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Gastric Heterotopia

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GASTRIC heterotopic tumor-like nodules are uncommon in the experience of any single surgeon. They consist of ectopic foci of glandular and ductal tissue within a muscular stroma. Although most of the nodules contain pancreatic acini and ducts, there is a broad structural gamut which includes Brunner's glands, biliary and pancreatic ductal elements, and related structures within muscle. Rarely, pancreatic islets are present. The nodules with fully developed pancreatic acini make up the great bulk of this group. They are well known by such names as aberrant, ectopic or heterotopic pancreas, or a fully differentiated pancreatic adenoma. Nodules without pancreatic acini form a small minority of this group. Unfortunately the nomenclature sometimes utilized for this latter group seems to isolate them from the common family of heterotopias by overemphasizing either the predominating histologic component or a presumed mechanism of pathogenesis. The variation of structure in this latter group is reflected in the terminology utilized: incompletely developed accessory pancreas, Brunner's adenoma, compound adenoma, adenomyoma, adenomyosis, myoepithelial hamartoma, choristoma, and so on.

In a classic review of almost 2,000 benign intramural gastric tumors reported prior to 1951, Palmer [17] summarized the available data regarding incidence, age and sex distribution, symptomatology, radiographic and gastroscopic features, and the gross pathology of 215 histologically proved cases of aberrant pancreas. He regarded the literature concerning the remainder of the family of gastric heterotopias as unsuitable for review.

The largest personally observed series was reported by Barbosa, Dockerty and Waugh [1]. All of their gastric tumors were heterotopic pancreas; nine were symptomatic, four were asymptomatic.

More recently Stout [20] has accumulated twenty-three unreported cases.

Almost all reports of heterotopic nodules without well differentiated pancreatic acini discuss single cases [4,6,8,23]. Magnus-Alsleben [12], however, described five cases discovered incidentally at autopsy. Mitchell and Angrist [15] also reported four asymptomatic gastric heterotopic tumors detected at autopsy; all included ductal structures foreign to the gastric wall but only two contained pancreatic acini. Stewart and Taylor [18] described four cases, three of which came to surgery. Clarke [5] reported four examples of surgically excised heterotopic nodules, of which two contained pancreatic acini whereas the other two did not. Three contained nests of Brunner's glands. All four contained pancreatic ductal structures within proliferating muscle. The symptomatology in these cases was not dependent on the presence of pancreatic acini. Clinically, one patient was asymptomatic. Two had significant epigastric distress, one had severe pain after eating, and the other had overt pyloric obstruction. The fourth case was complicated by an active duodenal ulcer and chronic cholecystitis.

It is becoming increasingly clear that past morphologic distinctions between fully differentiated heterotopias with pancreatic acini and the remainder of the family are artificial. The morphologic variants of this family range along a spectrum, but they are all basically similar. The common denominator is an ontogenetic error which results in the formation of epithelial elements not normally present in the stomach. When these misplaced elements proliferate they may form a tumor-like nodule [19]. Clarke [5] has pointed out that the diversity of histologic structure is dependent on the degree of differ-

entiation rather than on point of origin or original cell type.

It is becoming equally evident that the clinical panorama does not justify separation of the family of heterotopias since they behave similarly. The problem is no longer academic since the radiologist can often suggest the diagnosis preoperatively. It has been well known for several years that the typical aberrant pancreas may produce a distinctive radiographic pattern.

Recently, however, Cimmino [4] has stated that the radiographic picture is virtually identical for the less differentiated variants. He proposed that the radiologist make only a generic diagnosis (he used the generic term, adenomyosis). The specific diagnosis of the degree of determination of the heterotopia should be left to the pathologist.

For varying reasons the surgeon may enencounter an intramural gastric tumor without radiologic forewarning. In any event frozen section pathologic diagnosis offers the surgeon a practically infallible guide for his choice of surgical technic.

CASE REPORT

A. K. (No. 1992), a fifty year old white housewife, complained of epigastric pain with radiation to the back for six weeks. The pain was constant and persistent. It was not relieved by food. There was frequent belching and occasional nausea especially after ingestion of fatty food. Since cessation of menses one year previously, she had gained twenty pounds.

Physical examination disclosed only slight tenderness in the epigastric region and right upper quadrant.

Laboratory studies included hemoglobin 13.6 gm. per cent, hematocrit 42 per cent, leukocyte count 7,950 per cu. mm. with a normal blood smear. Urinalysis was negative. Complete blood chemistry study was negative. An electrocardiogram demonstrated sinus tachycardia.

Multiple roentgenograms demonstrated only a suggestive narrow contraction defect of the midthird of the duodenum with no ulcer crater and no intrinsic gastric lesion together with a normally functioning gallbladder containing non-mobile opacities suspected to be cholesterol polyps. The remainder of a gastrointestinal series, an intravenous pyelogram and roentgenograms of the chest were negative.

Exploratory laparotomy was performed on September 22, 1959. The gallbladder appeared normal on palpation. Cholecystotomy was done and no polyps or calculi were found. A postoperative cholecystogram and cholangiogram were normal. Examination of the pyloric sphincter disclosed a well circumscribed, intramural, ovoid, pinkish tan nodule 2.5 by 1.5 by 1 cm. The entire lesion was excised conservatively. The overlying mucosa and serosa were intact, and the surgeon saw no ductal orifice in the gastric mucosa.

Immediate frozen section disclosed heterotopic pancreatic ductules and Brunner's glands within the pyloric musculature creating a tumor-like enlargement. Multiple additional paraffin sections disclosed no pancreatic acini or lymphoid tissue. Separately submitted gastric mucosal specimens were unremarkable. (Figs. 1A and B.)

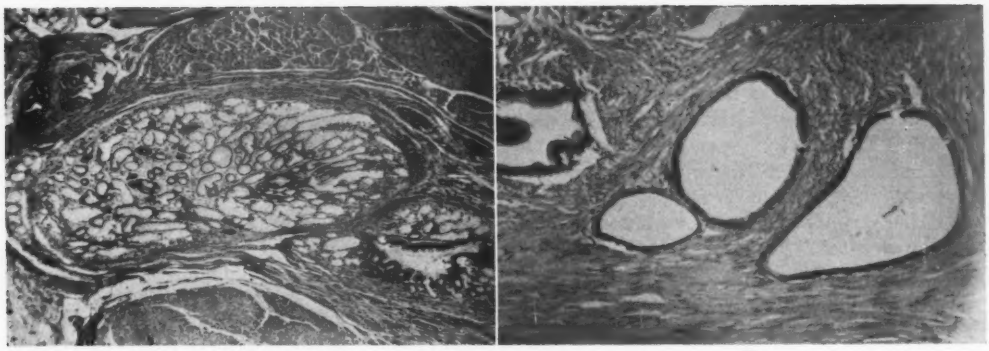
Aside from a minor wound infection of brief duration, the patient made an uneventful recovery and has been free of symptoms.

COMMENTS

Historically our knowledge of heterotopia has developed at an ever increasing pace. Schultz [3] made the first gross diagnosis of heterotopia in the gastrointestinal tract (not the stomach) in 1727. Klob [9] made the first histologic studies in 1859. In 1903 Magnus-Alsleben [12] reported five adenomyomata of the stomach discovered incidentally at autopsy. Krieg [10] states the first report of pyloric obstruction due to ectopic pancreas was made by Cecchini in 1886. Gruzdeff [8] is generally considered to have reported the first adenomyoma of the stomach to be observed clinically in 1909. Waugh and Harding [22] cite Reynier and Masson for an independent correlation of symptoms with gastric heterotopia in 1909.

In the first phase of studies, authors were concerned with describing the lesions and debating the embryologic and pathogenetic aspects. During the second phase, interest centered on the clinical features and possible complications. With the development of modern radiologic technics, emphasis has shifted to preoperative diagnosis, confirmation by frozen section and limited but curative surgical resection technics.

The average overall incidence of heterotopic pancreas in the gastrointestinal tract averages about 1 per cent in large autopsy series [1,22]. This figure is based on 191 instances in 17,685 autopsies from the series of Opie, Horgan, Duff, Derbyshire, Kremer, Katsurada, Feyrter, Mouchet, Letuelle and Barbosa et al. Approximately a quarter of these lesions are gastric [1]. Thus the overall incidence in the stomach is in the range of 0.25 per cent.



1A 1B

FIG. 1. A, low power magnification of Brunner's glands and ductal structures in a muscular stroma. B, mid-power magnification of purely ductal elements in a muscular stroma.

The average incidence of heterotopia in large reported series of gastrectomy specimens or of gastric tumors is approximately 0.67 per cent. Stout [*19*] reported six cases among 651 gastric tumors (one per 110), Marshall and Aranoff [*13*] recorded three among 464 gastric tumors (one per 155) and Waugh and Harding [*22*] noted four among 800 subtotal gastrectomies (one per 200). Barbosa et al. [*1*] suggested an incidence of one case per 500 operations in the upper abdomen at the Mayo Clinic.

The reported incidence of heterotopic nodules by sex varies. Barbosa et al. [*1*] report a male predominance of three to one. Waugh and Harding [*22*] report a male predominance of two to one. Palmer [*17*], however, reviews the largest number of cases of gastric tumors—sixty-eight males and seventy-six females. These nodules may be found from infancy [*21*] to old age but most are found in adults from twenty to sixty [*17,22*].

In Palmer's [*17*] collected series of 215 cases, 120 were found at operation performed for a preoperatively recognized gastric tumor as compared with seventy-four found at autopsy or incidental laparotomy. Twenty-one of Stout's twenty-three cases were from surgical material [*20*].

These tumors may be asymptomatic. Occasionally they are found by chance at laparotomy or at autopsy.

Some type of epigastric pain is the presenting symptom in the large majority of symptomatic cases. The pain may be constant rather than intermittent and may radiate to the back or shoulder. It may mimic peptic ulcer, disorders of the gallbladder or bile duct, or other gastrointestinal disturbances. A few patients presented with overt pyloric obstruction. Hemorrhage due to ulceration of the overlying mucosa is rare. The symptomatology is not specific. At best it indicates the need for gastrointestinal radiologic study.

The lesion usually occurs within 6 cm. from the gastroduodenal junction within the pylorus or antrum. It is almost invariably a single mass which is small; few exceed 4 cm. in size. In only one reported case did it reach palpable proportions. Since the mass is predominantly intramural, it is not mobile as a pedunculated polyp would be. Nodules occur with equal frequency on the anterior and posterior walls and on either the greater or lesser curvature. Gastroscopy or gastrotomy permits delineation of a hemispherical or conical mass which bulges into the lumen. The overlying mucosa is usually intact; superimposed ulceration is rare. The rugal pattern in the vicinity is usually normal. Benner [*2*] has especially stressed a prominent mucosal feature largely ignored by most previous observers. In all of his five cases he noted a centrally placed umbilication (pouch, pit, dimple, invagination, pseudodiverticulum) surrounded by a mucosal lip. Sometimes ductal structures radiated from the central pit. This central umbilication, sometimes misconstrued in radiologic literature as a "pancreatic duct," is actually an invagination lined by gastric mucosa. Since all of Benner's cases were heterotopic pancreas, this mucosal alteration came to be regarded as a pathognomonic feature of heterotopic pancreas especially by

radiologists. Since Cimmino has reported a heterotopic nodule without pancreatic acini but with the typical umbilication, it seems more reasonable to regard this associated mucosal alteration as a generic rather than a specific pathognomonic feature.

On cut section the nodule may lie in the submucosa, muscularis, subserosa or any combination of these. In one study of twenty-six cases 54 per cent involved the submucosa, 23 per cent involved submucosa and infiltrated between muscle fibers, 8 per cent were found between muscle fibers only, 11 per cent involved the subserosa only and 4 per cent involved all layers. In another study of thirty-three cases, Delhougne [7] reported submucosal involvement in fifteen cases, intramural involvement in five cases, subserosal involvement in five cases, and simultaneous involvement of multiple layers in eight cases. Again Palmer [17] surveyed the largest number of cases. He records 113 cases (73 per cent) involving the submucosa, twenty-seven cases (17 per cent) were in the muscularis propria, and 16 cases (10 per cent) were distinctly subserosal.

The heterotopic nodule forms an ovoid, circumscribed, non-encapsulated, firm mass which may consist largely of brownish muscle or predominantly of light cream, white or yellow glandular and ductal elements. Ducts may stand out as pinhead-sized translucent foci or minute cysts. Fine lobulation may be grossly visible.

The radiographic pattern reflects the gross pathologic features of the lesion. Small lesions may not be detectable. Many lesions will present the pattern of a benign gastric tumor; there will be a sharply circumscribed ovoid immobile filling defect, rarely over 4 cm. in diameter, usually within the pylorus or antrum. The peristaltic pattern is essentially normal. It may not always be possible to differentiate the more common gastric polyp or gastric leiomyofibroma from the heterotopic nodule. If there is a central dimple, invagination, umbilication or depression which changes slightly in diameter, with normal surrounding mucosa, with normal peristalsis obliterating the lesion at times, and if ducts can be visualized entering the central dimple, the diagnosis of heterotopia is very likely. Standard texts on radiology still refer to this pattern as that of an aberrant pancreas [14]. It is therefore worth repeating Cimmino's injunction: there are no significant differences in radiologic patterns in the family of heterotopias. The specific term aberrant pancreas should be abandoned by the radiologist in favor of the generic term (he used the term adenomyosis rather than heterotopia). Cimmino [4] as well as Littner and Kirsh [11] have offered helpful hints on radiologic differential diagnosis.

The microscopic appearance of the epithelial components or heterotopic nodules must already be apparent from preceeding paragraphs. A comment should be added about the muscular component. Most authors make no comment about the muscle. Some regard it as normal muscle invaded by epithelium. Usually, however, there is a definite but variable increase of muscle tissue; the irregular proliferated mats of muscle around glandular and ductal tissue merge imperceptably with adjacent normal muscle. It appears more reasonable to suspect secondary stimulation of muscle when the heterotopic epithelium proliferates but there may also be an original ontogenetic error involving smooth muscle in some cases.

Microscopic diagnosis by frozen section at the time of operation is essential if unnecessary radical surgery is to be avoided. The correct diagnosis was thus made promptly in practically all of the cases reported by Barbosa, Dockerty and Waugh [1]. It is highly improbable that a competent pathologist could misconstrue the normal epithelial elements within hypertrophied muscle as metastatic carcinoma.

One case of carcinoma of the stomach apparently arising in a heterotopic pancreatic nodule has been described by Nicholson [16].

Since there is now adequate evidence that all of these heterotopic tumors follow an essentially similar clinical course, that the radiographic pattern is basically similar, and that the seemingly diverse spectrum of morphologic variants has an ontogenetic common denominator, it would avoid confusion if this family of tumors were consistently designated by a single generic term. Stout's designation of heterotopic tumors, if followed by a parenthetic designation of the morphologic variant, would result in the least confusion. The term hamartoma (myoepithelial hamartoma of Clarke) is more properly used to designate a malformation in an organ composed of scrambled tissues of the organ itself [20]. In the nodules with which we are concerned the epithelial elements are obviously foreign to the stomach. The terms

adenomyoma and adenomyosis have been used in the past by several authors specifically to include all variants except the fully differentiated heterotopic pancreas which has been specifically excluded [*18,23*]. The suggested use of this term to include the entire group of heterotopic nodules is potentially confusing. In addition, it should be recollected that adenomyomatous lesions of the gallbladder or uterus usually contain epithelial tissues normal to the organ but enmeshed within the muscle. A strictly morphologic designation (such as Brunner's or compound adenoma) objectionably stresses only one facet of this family while ignoring the common denominators.

Complete but conservative surgical excision is the treatment of choice. At times pyloroplasty may be necessary. When this lesion is the cause of the patient's symptoms, excision is curative.

SUMMARY

1. A patient with a benign pyloric gastric heterotopic nodule without pancreatic acini presenting with epigastric pain and cured by surgical excision is presented.

2. Relevant data and concepts regarding gastric heterotopia are reviewed with emphasis on the less common variants without well differentiated pancreatic acini.

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Results of Treatment of Squamous Cell Carcinoma of the Upper Jaw and Antrum

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WE have reviewed the progress of treatment of squamous cell carcinoma of the anterior portion of the tongue, the floor of the mouth and the mandibular gingiva in several previous communications [4–6]. In the past, the treatment of carcinoma of the upper jaw and the maxillary antrum has centered about the difficult problem of control of the primary lesion; this was usually attempted by electrosurgical removal of the tumor and/or by treatment of the tumor by radiation. The results of treatment of tumors in this difficult region have not been good. In more recent years, with surgical and anesthetic advances, open surgical removal of the maxilla and antrum has been employed more frequently. Some investigators believe that this represents the best approach to maxilloantral cancer; others think that more can be accomplished by radiation treatment, and a growing number of oncologists are employing both methods in a combined simultaneous program to attempt to eradicate this terrible disease located in a most difficult area.

It is the purpose of this study to determine the results of treatment of all patients with squamous cell carcinoma of the upper jaw and antrum treated at the Mayo Clinic from 1945 to 1954 inclusive, and, if possible, to determine the most effective form of treatment.

GENERAL PROGRAM OF TREATMENT

During the ten-year period, 1945 to 1954 inclusive, no one rigid form of treatment was employed at the clinic for patients with squamous cell carcinoma of the upper jaw and antrum. However, we usually adhered to a general program of treatment. A few patients with extremely extensive tumors were treated by radiation only. A somewhat larger group of patients with small or low grade (Broders' method) tumors were treated by removal of the tumor locally, without adjunctive radiation therapy. These small lesions were usually removed by electric scalpel followed by more extensive electrocoagulation of the remaining base of the wound. Most maxilloantral malignant lesions were treated by combined electrosurgical removal of the local tumor and supplementary radiation. As a rule, the tumors were removed by thorough electrocoagulation, and only in the later years of the study were open maxillectomies employed. At the time of removal of the primary tumor by electrocoagulation, the resultant defect or cavity (antrum) was packed with radium. In most cases additional external radiation was used to supplement the intracavitary radium therapy. In some cases, no intracavitary radium was used, the total dosage being from external sources. In the more recent years of the study, the upper jaw and antrum were removed by open operation and, as mentioned earlier, supplementary radiation was used. Recurrent lesions were treated as individual problems by electrocoagulation, radon seeds, external radiation, or a combination of these modalities.

Because of the lower incidence of cervical metastasis in squamous cell carcinoma of the upper jaw and antrum, as compared to the tongue, and because of the questionable ability to control the primary lesion, prophylactic dissection of the cervical lymph nodes has not been employed in the treatment program. Patients with clinical cervical metastasis usually were treated by block dissection of the neck. However, in some instances, the involved cervical lymph nodes lay within the treatment field of

the primary lesion and were thus treated by radiation. As a rule, patients having extensive fixed cervical metastatic lesions were treated by interstitial radon seeds or external radiation.

FACTORS OF SELECTION

During this ten-year period, 269 patients with histologically proved squamous cell carcinoma of the anterior part of the tongue, 102 patients with squamous cell carcinoma of the floor of the mouth, and 118 patients with squamous cell carcinoma of the mandibular gingiva were treated at the Clinic [4–6].

Also during the ten-year period of this study, 174 patients with histologically proved invasive squamous cell carcinoma of the upper jaw and antrum were treated at the Clinic. These patients form the basis for this study.

Included in the group of 174 patients were all patients whose tumors arose from the upper alveolus or hard palate or from the maxillary antrum. Because of the impossibility of determining the exact site of origin of lesions about the antrum and upper jaw, these two regions were combined for this study. Tumors that appeared to arise in the nasal fossa were excluded as were tumors that arose on the buccal mucosa, although these tumors may have secondarily invaded the antrum or upper jaw. Tumors that arose on the soft palate were excluded. All patients with histologically proved invasive squamous cell carcinoma who received any form of treatment at the Clinic were included, regardless of how little treatment was given or how short the period of observation. One patient was treated without biopsy, but is excluded from the study. Forty-eight patients who were not treated and were excluded came to the Clinic for consultation only, refused treatment, sought treatment elsewhere, or returned home for palliative treatment for advanced malignant disease. In this latter group, histologic examination of tissue was not available in all instances and many of the lesions may have represented malignant lesions other than squamous cell carcinoma.

DATA IN PRESENT STUDY

Age and Sex Distribution. The mean age of the 174 treated patients was 58.6 years, ranging from twenty-nine to eighty-three years. A total of 119 (68.4 per cent) of the patients were men and fifty-five (31.6 per cent) were women.

Location and Extension of Lesions on Patients' Admission. Seventy-five (43.1 per cent) tumors arose on the right side, ninety-two (52.9 per cent) on the left side, and seven (4.0 per cent) in the midline. Involvement of the antrum or extension of an alveolar tumor to the antrum was present in 119 cases (68.4 per cent). In twenty-nine cases (16.7 per cent) involvement of the ethmoid sinus regions was evident. Involvement of the orbit was present in forty-two patients (24.1 per cent). Involvement of the lateral wall of the antrum was present in thirty-seven patients (21.3 per cent). The lesions extended to the pharynx, posterior commissure or pterygoid region on admission in fifteen patients (8.6 per cent).

Metastatically involved cervical lymph nodes were present on admission in fifteen patients (8.6 per cent).

Histologic Grade of Lesions. The degree of malignancy of these tumors (Broders' method) was recorded. Twenty-nine (16.7 per cent) were grade 1, fifty-three (30.5 per cent) were grade 2, forty-nine (28.1 per cent) were grade 3, and forty-three (24.7 per cent) were grade 4.

Previous Treatment. Of the 174 patients, sixty-six (37.9 per cent) had undergone some attempt, excluding biopsy and local applications, to control their malignant disease prior to coming to the Clinic.

Multiple Cancerous Lesions. Additional malignant tumors (exclusive of skin cancers) were present or developed later in nineteen (10.9 per cent) of the 174 patients. In fourteen patients, these tumors arose in other parts of the oral cavity.

Treatment of Primary Lesion. The first therapeutic attempt represents the best opportunity to control the malignant lesion and, to prevent confusion, only the first treatment employed at the Clinic to control the primary lesion is listed in Table 1. Obviously, in many instances, the tumor recurred and further treatment was given.

As stated previously, the patients who were treated by electrocoagulation alone usually had tumors that were less extensive and of lower average histologic grade. The patients treated by radiation alone usually had extensive high grade lesions. It is possible that some patients refused surgical treatment and were treated by radiation only as a second choice.

Most patients were treated surgically or by electrocoagulation plus radiation. In the patients treated in this manner the tumors were

TABLE I
INITIAL TREATMENT OF PRIMARY LESION

Treatment	No. of Patients
Operation only	2
Electrocoagulation only	66
Operation or electrocoagulation plus radiation	89
Radiation only	17
Total	174

more extensive and of a higher grade of malignancy than were those of patients treated by electrocoagulation alone. After removal of the local primary lesion, radium was packed in the antrum, especially in cases in which complete removal of the tumor was uncertain. This procedure was often supplemented by external radiation to the region involved by the tumor. In some instances, external radiation alone was used in preference to intracavitary use of radium.

Exenteration of the orbit was carried out at the time of initial treatment in fourteen cases, and at a subsequent date in five additional cases.

Treatment of Cervical Lymph Nodes. Fifteen patients (8.6 per cent) had metastatically involved cervical lymph nodes on admission to the Clinic. The treatment used was radical block dissection in six cases, radical block dissection plus external radiation in two cases, and radium, radon or external radiation in the remaining seven cases. In seven of the eight patients who were treated by radical block dissection, the treatment of the cervical lymph nodes could definitely be dissociated from the treatment of the primary lesion. In only two of the seven patients was control of cervical metastasis obtained. Radiation was totally ineffective in controlling cervical metastatic growths. Whether radiation can sterilize small impalpable nodes that may contain tiny metastatic deposits and that lie within the treatment field of the primary lesion is, of course, unknown.

In thirty cases, cervical metastasis was known to have occurred subsequent to admission of the patients. Thus, cervical metastasis was known to have occurred in at least forty-five patients (25.9 per cent) at some time during the study. In fifteen of the thirty patients in whom metastatic lesions were found subsequent to admission, radical block dissection was used. Block dissection was effective in controlling cervical metastasis in four of nine cases in which definite dissociation of control of cervical metastasis from control of primary lesions could be obtained. The remaining fifteen patients were treated by radium and/or external radiation, but in none was cervical metastasis controlled.

Crossed metastasis, that is, metastasis to the side of the neck opposite to the primary lesion, was known to have occurred at some time during the course of study in eleven cases (6.3 per cent).

TABLE II
SURVIVAL DATA ON 162 PATIENTS TREATED AT MAYO CLINIC (1945–1953,* INCLUSIVE)

Treatment	No. of Patients		Lived Five or More Years after Treatment	
	Total	Traced	No.	Per cent†
Electrocoagulation only	62	61	31	50.8
Operation or electrocoagulation plus radiation	84	83	32	38.6
Radiation only	16	16	0	...
Total	162	160	63	39.4

* Twelve patients treated during 1954 were ineligible for five-year survival rate.

† Based on traced patients; last inquiry made on January 1, 1959.

SURVIVAL OF PATIENTS

Table II summarizes survival data on 162 of the 174 patients with squamous cell carcinoma of the upper jaw and antrum. The twelve patients treated during 1954 were ineligible for calculation of the five-year survival rate. The five-year survival rate for the 160 patients who could be traced is 39.4 per cent.

The survival of patients according to the method of treatment employed and considering the severity of lesions was studied. The patients treated by radiation alone had advanced

tumors, and the lack of even one survivor in this group does not represent what radiation alone can do for this disease. The survival of 50.8 per cent of those treated by electrocoagulation alone is rather favorable. It must be remembered, however, that this group of patients had smaller lesions which usually were of low histologic grade. The large group treated by both radiation plus electrocoagulation or operation had extensive high grade tumors.

Of additional interest is the relationship between the location and extent of the tumor and survival, irrespective of the type of treatment employed. Of the 162 patients eligible for five-year survival determinations, 110 patients had involvement of the maxillary antrum. One patient was not traced and the five-year survival rate of the 109 was 35.8 per cent (thirty-nine patients).

Twenty-seven of the 162 patients had evidence of involvement of the ethmoid region by their tumors. The five-year survival rate of the twenty-six patients who could be traced was 30.8 per cent (eight patients).

Of the 162 patients, thirty-nine had involvement of the orbit. Nine of the thirty-nine survived five years, the five-year survival rate for the group being 23.1 per cent. In fifteen patients the pharynx, posterior commissure or pterygoid region was involved. Three of the fifteen patients survived five years, giving a five-year survival rate of 20.0 per cent. The lateral wall of the maxillary antrum of thirty-four patients was involved. Since seven of the thirty-four patients survived for five years, the five-year survival rate for the group is 20.6 per cent. There were fifteen patients with metastatically involved cervical nodes on admission. Three of the fifteen patients (20.0 per cent) survived for five years or more.

Of the eighty-four patients who were treated by electrocoagulation or surgical procedures plus radiation and who were eligible for five-year survival calculation, the effectiveness of initial control of the primary lesion was determined. In nine of the eighty-four cases, the control of the primary lesion could not be ascertained because of factors such as uncontrolled metastasis to the neck. In the remaining seventy-five patients a definite statement could be made regarding control of the primary maxilloantral lesion. In fifty-one cases, the initial combined treatment did not control the primary lesion. However, in some cases in which the primary lesion was not controlled initially, subsequent treatment was effective and several of the patients lived five or more years. Thus, although the primary lesion was controlled initially in less than one-third of the patients in this group, persistent close observation and judicious treatment saved some patients so that the survival rate for the group was increased to 38.6 per cent.

COMMENTS

In the past there has been considerable controversy regarding the merits of various methods of treatment of carcinoma of the maxillary jaw and antrum. This controversy centers not only around the use of electrosurgery or open surgical removal of the neoplasm but also around the use of radiation therapy. This has been discussed in detail by Devine, Scanlon and Figi [3]. In spite of the controversy over the various methods of treatment, according to Larsson and Martensson [8] and New and Cabot [11], probably the best results can be obtained in this terrible disease by judicious use of surgical measures or electrosurgery combined with a program of radiation therapy. Whether the upper jaw or a portion of it is removed surgically or by electrosurgical means does not appear to make much difference. The radiotherapist usually prefers external radiation or teleradiation with cobalt-60 (Co^{60}) to the intracavitary use of radium. At the time of this study, not only these authors [8,11] but also MacComb and Fletcher [9], Mattick and Streuter [10], Paletta and Weir [12], and Schall [13] favor a combination of both surgical and radiation treatment in an all-out effort to eradicate the disease initially, rather than employment of one modality only and "waiting to see" whether or not the tumor recurs. Better results are being achieved by this combination of methods. This is fundamentally the approach that was employed in the majority of patients treated at the Clinic. We have not employed the method described by Paletta and Weir, who suggest the immediate use of radiation to the postoperative cavity.

Because of the low incidence of cervical metastasis among the patients on their admission, and because of the difficulties in controlling the primary lesion, we are not of the opinion that block dissection of the cervical lymphatics should be performed in the absence

TABLE III

CARCINOMA OF UPPER JAW AND ANTRUM: REPORTED SERIES

Authors	Time of Treatment (yr.)	No. of Cases	Factors of Selection	Predominant Treatment		Survival Rates	
				Primary	Neck	Five-Year Determinate	Five-Year Absolute
Windeyer	1925–1937	Total, 94; treated, 82	Maxilla, antrum, palate; all histologic types	Radium or x-ray therapy	Radiation	17 of 82 patients (20%)	.....
Mattick and Streuter	1936–1946	Total, 68	Maxillary antrum, all cases	Radium or x-ray therapy	.....	.....	10.3%
Frazell	1935–1947	Determinate, 173	Paranasal sinuses, unselected	Radiation and operation	Dissection	22.5%	.....
Cranmer	1932–1948	Total, 91	Paranasal sinuses, all histologic types	Electrocoagulation and radiation	.....	.....	14%
Wille	1932–1944	Total, 220	Nose and accessory sinuses; all histologic types	Electrocoagulation or operation and x-ray therapy	.....	.....	11.4%
Larsson and Martensson	1940–1950	Total, 294; treated, 256	Nose and paranasal sinuses; all histologic types	X-ray therapy, electrocoagulation, intracavitary radium	Dissection	68 of 256 patients (27%)	68 of 294 patients (23%)
New and Cabot	Before 1929	Operated, 295; traced, 236	Upper jaw and antrum; operated patients only	Electrocoagulation and radiation	Dissection or radiation	52.8%	.....
Clifton and Hardin	1932–1955	Eligible,* 15	Upper gingiva	Radiation	.....	.....	5 of 15 patients (33%)
Schall	1930–1945	219	Nose and accessory sinuses; all histologic types	Operation and radiation	.....	.....	62 of 219 patients (28.3%)
Mayo Clinic	1945–1953	Eligible,* 162	Upper jaw, hard palate, antrum; squamous cell carcinoma	Electrocoagulation, operation and radiation	Dissection or radiation	39.4%	.....

* Eligible = patients treated five or more years before date of inquiry.

of clinical evidence of involvement. A clinically involved node that can be readily incorporated in the field treated by radiation should be included. However, block dissection may be required at a later date if cervical metastasis is not controlled. Cervical metastatic lesions outside the field of radiation treatment should be removed by block dissection of the neck.

Survival data from reported series in the literature are given in Table III. The locations of the tumors in our series must be considered in comparing our survival data with those reported in other series. Likewise, our series is limited to squamous cell carcinoma. Considering this, survival obtained by a program of treatment in which combined surgical measures and radiation predominate has produced favorable results.

SUMMARY

A study of 174 patients with squamous cell carcinoma of the upper jaw and antrum who were treated at the Mayo Clinic was undertaken. A five-year survival rate of 39.4 per cent was obtained for the traced patients.

Although more patients survived who were treated by electrocoagulation alone, these patients had less extensive tumors and tumors of lower histologic grade. The favorable survival rate obtained in the more extensive higher grade lesions, treated by a program of electrocoagulation or surgical removal combined with radiation therapy, led us to the conclusion that this probably represents the best treatment for the majority of patients having squamous cell carcinoma of the upper jaw and antrum.

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Perforation of the Gallbladder

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THERE is disagreement about the incidence of perforation of the gallbladder. Ogilvie [1] has said, "I personally have never seen a case of acute cholecystitis in which the gallbladder burst." Doubilet and Mulholland [2] stated that "So-called rupture and perforation of the gallbladder as complications of acute cholecystitis are not devastating catastrophes. Leakage of bile is small in quantity . . . omental protection . . . is efficient and prompt." The latter authors advise against early surgery in cases of acute cholecystitis; the patients should have "active medical therapy"—gastric suction, opiates, intravenous fluids, antibiotics and anticholinergic drugs—with surgery later "during a quiescent stage of the disease."

Wallace and Allen [3], on the other hand, found that gangrene and perforation are the chief causes of mortality in acute cholecystitis. However, gangrene with perforation was unusual before the sixth day after the onset of symptoms, and their morbidity and mortality rates were highest in those patients operated upon between the fourth and the twelfth day of the attack. Allen recommended operation within four days of the onset of symptoms; if this was not possible, he advised waiting out the attack with non-operative measures and close observation for signs of perforation.

This time between the fourth and twelfth day has been called the "critical period," and many surgeons subscribed to the idea of not operating during this time [4].

Ross, Boggs and Dunphy [5] studied hundreds of gallbladders removed during all stages of cholecystitis (from a few hours to several months after onset). They found that resolution of the inflammatory process is slow and incomplete, regardless of the clinical appearance of the patient. Dunphy stated, "After a short period devoted to restoration of fluid balance and beginning antibiotic therapy, there is nothing to gain by delaying surgery." These authors believe that the so-called "critical period" between the fourth and twelfth day is dangerous due to the inflammatory process reaching its peak at this time, rather than whether surgery is performed or withheld. The inflammatory process persists in the gallbladder for months and sometimes years. There may never be a "quiescent stage" of the disease as adjudged clinically. The surgery actually becomes more difficult as time goes on. In addition, perforation of the acutely inflamed gallbladder does occur and is dangerous. These and other authors reporting perforations give a widely varying incidence (from 6 per cent [6] to 25 per cent [7]) of their occurrence with acute cholecystitis, with high morbidity and mortality rates.

Glenn [8] in 1932 began operating early in acute cholecystitis, particularly in older people. He and others [5,6,9] have since shown that early surgical treatment, by interrupting the disease process before perforation can occur, appreciably lessens morbidity and mortality. Glenn operates "when the patient is adequately prepared, unless some condition exists that is not immediately reparable and which contraindicates operation."

In view of the conflicting reports and opinions on perforated gallbladder, I reviewed the cases seen at the Saint Francis Hospital, La Crosse, Wisconsin, in order to determine our incidence here and the results of management.

PRESENT STUDY

During the twenty-one–year period 1937 to 1958, there were 1,072 cases of acute cholecystitis at Saint Francis Hospital, with twenty-four perforations (an incidence of 2 per cent). The mortality rate from acute cholecystitis was 3.5 per cent, from perforation 25 per cent. (Table 1.)

TABLE I
INCIDENCE OF PERFORATION OF GALLBLADDER (SAINT FRANCIS HOSPITAL, 1937–1958)

	No. of Cases	No. of Deaths	Mortality (%)
Acute cholecystitis	1,072	38	3.5
Perforation	24 (2%)	6	25

In 1934 Niemeier [11] classified ruptured gallbladders as (1) acute free perforation (with generalized peritonitis); (2) subacute perforation (with abscess formation); and (3) chronic perforation (with fistula). (Table II.)

Acute Free Perforation, Saint Francis Hospital (Table III). There were four cases of acute free perforations, with two deaths. Only one was diagnosed correctly; this patient was the only one with a past history of gallbladder disease. Two were men and two, women; the average age was fifty-eight. The average duration of symptoms before entering the hospital was two and a half days. Two patients were operated upon within six hours of admission, and both lived. One was treated by cholecystostomy and the other by "partial cholecystectomy."

The two patients who died had the clinical picture of generalized peritonitis, and had been considered "not in shape for surgery" since admission; however, both lived nine days. The diagnoses were not established until autopsy.

All four of these patients had free fluid in the peritoneal cavity, but in only two was it bile-stained. As Cowley and Harkins [12] point out, a diseased gallbladder has lost its concentrating power. The obstructing stone in the cystic duct which initiates the attack of cholecystitis precludes the further admission of bile. When the gallbladder perforates, it may contain no bile at all.

TABLE II
PERFORATION OF GALLBLADDER: CLASSIFICATION AND MORTALITY

Classification (Niemeier)	No. of Cases	Per cent	No. of Deaths	Mortality (%)
Type 1: Acute free perforation	4	17	2	50
Type 2: Subacute perforation with abscess	15	62	4	27
Type 3: Chronic perforation with fistula	5	21	0	0
Total	24		6	25

Our mortality rate for acute perforation of the gallbladder was 50 per cent.

Subacute Perforation with Abscess, Saint Francis Hospital (Table IV). There were fifteen patients with subacute perforation and abscess formation (seven men and eight women); the average age was sixty-seven. The average duration of symptoms before entering the hospital was six and a half days. Six patients, or 40 per cent, had a previous diagnosis of cholelithiasis.

Of these fifteen patients, five underwent cholecystectomy, one with exploration of the common duct (this patient died). Nine cholecystostomies were performed (two on one patient; this patient perforated twice, two years apart), with two deaths following the procedure. Two patients had drainage only of a subhepatic abscess, and one died.

Our mortality rate for subacute perforation of the gallbladder (four deaths of fifteen cases) was 27 per cent. Cholecystostomy was the treatment most often used (nine cases), but cholecystectomy was successful in four cases.

Chronic Perforation with Fistula, Saint Francis Hospital (Table V). These interesting cases are

TABLE III
ACUTE FREE PERFORATION OF GALLBLADDER

No. of cases	4 (2 men, 2 women)
Age (average)	58 yr. (53–67)
Duration of symptoms	2.5 days
Past history of biliary disease	1 case (25%)
Management	2 operated on immediately, lived 2 not operated on, died in 9 days
Operations	1 cholecystostomy 1 partial cholecystectomy

TABLE IV
SUBACUTE PERFORATION OF GALLBLADDER WITH ABSCESS

No. of cases	15 (7 men, 8 women)
Age (average)	67 yr. (56–83)
Duration of symptoms	6.5 days
Past history biliary disease	6 cases (40%)
Operations (average, 4.8 days after admission)	9 cholecystostomies, 2 died 4 cholecystectomies 2 drainage only, 1 died 1 choledochostomy, 1 died

TABLE V
CHRONIC PERFORATION OF GALLBLADDER WITH FISTULA

No. of cases	5 (2 men, 3 women)
Age (average)	67 yr. (53–74)
Past history of biliary disease	5 cases (100%)
Viscus involved in fistula:	
Duodenum	3 cases
Stomach	1 case
Perforation into abdominal wall	1 case
Enteric fistulas	4 cases
Asymptomatic	1 case
Gallstone ileus	3 cases (1 passed stone spontaneously)

TABLE VI
PATHOGENESIS OF CHOLECYSTITIS
(THOMAS AND WOMACK [13])

1. Obstruction of cystic duct (stone usually)
2. Action of concentrated bile in gallbladder
3. Impairment of blood supply by distention
4. Secondary bacterial infection
5. Necrosis and perforation (fundus usually, frequently walled off)

TABLE VII
SYMPTOMS OF PERFORATION OF GALLBLADDER

Symptoms	Acute (4 cases)	Subacute (15 cases)	Chronic (5 cases)
Pain in right upper quadrant (severe)	3 (75%)	13 (87%)	2 (40%)
Nausea	4 (100%)	13 (87%)	4 (80%)
Vomiting	4 (100%)	12 (80%)	4 (80%)
Pain radiating to back	1 (25%)	5 (33%)	0
Generalized abdominal pain	1 (25%)	2 (13%)	3 (60%)

actually in a class apart from the acute and subacute perforations. They represent an end point of acute cholecystitis, terminating with a spontaneous "internal cholecystostomy." Five patients were included in this group (two men and three women); their average age was sixty-seven. Four had cholecystoenteric fistulas (three to the duodenum and one to the stomach). One patient's gallbladder had perforated into the anterior abdominal wall, producing a mass which was thought to be a tumor. At operation, gallstones were found interspersed among the fibers of the right rectus muscle. Cholecystectomy and repair of a ventral hernia were successfully performed.

Of the cholecystoduodenal fistulas, one was an incidental finding at autopsy. The patient died of heart disease, with a history of one severe attack of cholecystitis five years previously and no trouble since. A fistula was present between the gallbladder and duodenum; there had never been a "gallstone ileus" or an ascending cholangitis.

Three of these patients presented with acute small bowel obstruction due to gallstone obturation. Two were operated upon successfully (enterotomy and removal of stone); one passed the obstructing stone per rectum spontaneously.

Definitive gallbladder surgery was not performed upon any of these patients except the one with the fistula to the abdominal wall. There were no deaths.

PERFORATING CHOLECYSTITIS

Pathogenesis (*Table VI*). Thomas and Womack [*13*] showed in dogs that gangrenous cholecystitis with perforation could be produced if (1) the dog's bile was concentrated (this was first produced by injecting concentrated bile into the gallbladder but a more physiologic method was devised, namely, starving the animals); and (2) the cystic duct and cystic artery were both tied off. These authors concluded that the pathogenesis of cholecystitis involves: (1) obstruction of the cystic duct (usually from an impacted gallstone); (2) action of concentrated bile in the gallbladder; (3) impairment of the blood supply by distention; (4) secondary bacterial infection; and (5) necrosis and perforation.

Diagnosis. The symptoms and signs of perforation of the gallbladder (Tables VII and VIII) are those of acute cholecystitis but of greater severity. Saint [*14*] stressed the importance of an expanding mass in the right upper quadrant of the abdomen, an increasing pulse rate, a rise in temperature, and increasing leukocytosis as signs of impending or actual perforation.

Severe, unremitting pain in the right upper quadrant of the abdomen was the outstanding symptom in our cases. The chief finding was marked tenderness and muscle spasm in the right upper quadrant. The presence of a mass was not often noted.

Two recent patients presented with right pleural effusion turning into empyema, cultures of which grew Escherichia coli. These two patients had experienced the sudden onset of abdominal pain which persisted, and marked tenderness in the right upper quadrant indi-

TABLE VIII
SIGNS OF PERFORATION OF GALLBLADDER

Signs	Acute (4 cases)	Subacute (15 cases)	Chronic (5 cases)
White blood cell count (average)	23,000 per cu. mm.	16,000 per cu. mm.	11,000 per cu. mm.
Temperature (average)	103.2°F.	101°F.	99.2°F.
Tenderness in right upper quadrant	3 (75%)	14 (95%)	1 (20%)
Mass in right upper quadrant	0	4 (27%)	0
General tenderness	1 (25%)	2 (13%)	2 (40%)
Jaundice	1 (25%)	3 (20%)	0
Pleural effusion	...	2 (13%)	...

TABLE IX
PREOPERATIVE DIAGNOSIS IN NINETEEN CASES OF ACUTE AND SUBACUTE PERFORATION

Diagnosis	No. of Cases
Ruptured gallbladder	4 (21%)
Acute cholecystitis	5
Empyema of gallbladder	3
Subphrenic abscess	1
Perforated ulcer	2
Ruptured appendix	2
Peritonitis	1
Bowel obstruction	1

TABLE X
PATHOLOGY OF PERFORATION OF GALLBLADDER

1938–1941: 10 cases, 4 deaths	40% mortality
1945–1958: 14 cases, 2 deaths	14% mortality
Gallstones	23 cases (96%)
Carcinoma	1 case
Site of perforation:	
Fundus	8 cases
Ampulla	2 cases
Not stated or unknown	14 cases
Bateriology:	
E. coli	4 cases
M. pyogenes	1 case
A. cloacae	1 case

cated the subdiaphragmatic origin of their disease.

Eleven of our twenty-four patients (46 per cent) were men. Other studies also show this disproportionate incidence, indicating the tendency toward complications of male patients with gallbladder disease.

In most of these cases it was impossible to ascertain when the gallbladder actually perforated in relation to the onset of the attack. It appeared that only one perforated in less than forty-eight hours, and the remainder not for at least six days after the onset, which corresponds to the experience of Wallace and Allen [3].

Preoperative Diagnoses (*Table IX*). Of nineteen cases of acute and subacute perforation, four were diagnosed correctly preoperatively; eight others were considered either acute cholecystitis or "empyema of the gallbladder."

It is apparent that there are no pathognomonic symptoms or signs unique to perforating gallbladder. However, one should suspect it when acute cholecystitis persists longer than four days, particularly in older patients and in men.

Pathology and Bacteriology (*Table X*). The mortality rate in the earlier part of our series (1938–1941) was 40 per cent. From 1945 until 1958 the mortality rate was 14 per cent. Twenty-three of twenty-four cases had gallstones. There was one patient with carcinoma of the gallbladder which perforated; this patient died. The site of perforation was specifically noted in only ten cases; in eight of these the site was the fundus and in two it was the ampulla.

Bacteriologic data, scattered and incomplete, showed E. coli in four cases, Micrococcus pyogenes in one case and Aerobacter cloacae in one case.

COMMENTS

It would appear that most cases of acute cholecystitis do not perforate, and we hesitate to stress the danger of it since it only occurred in 2 per cent of our cases. Confronted with a case of acute cholecystitis, medical treatment is probably indicated at first. However, the process is primarily obstructive [14–16], and what one can expect from medical measures, particularly antibiotics, is questionable. As

Hanlon [16] says, "Bile cultures are seldom positive before the sixth day of the attack. If one waits till acute cholecystitis has become a bacteriological problem then the incidence of perforation is . . . high."

Only one common duct exploration was performed in twenty-four cases. Four patients were jaundiced (one with acute perforation and three with subacute perforation). The jaundiced patient with acute perforation died, with stones in the common duct and abdomen. One of the patients with subacute perforation who was jaundiced died nine days after cholecystectomy and exploration of the common duct. Two recovered following cholecystectomy alone, the jaundice disappearing.

Morse [10] stated, "Perforation occurs more frequently in older people, and they die because localization does not materialize. This should be considered before a 'cooling off' period is initiated in an older patient with acute cholecystitis."

It appears that when a patient has acute cholecystitis, concurrent cardiac, pulmonary or metabolic disorders should be sought after and corrected. If the attack shows no sign of subsiding or is getting worse, there is little to gain by waiting, and possibly much to lose.

Local and intercostal block anesthesia can be used. These procedures are not difficult and can be self-taught. They work well in conjunction with light general anesthesia. They are especially adequate for drainage of an abscess or cholecystostomy.

Cholecystectomy is the treatment of choice, but cholecystostomy with removal of stones is simple and effective.

SUMMARY

In 2 per cent of the cases of acute cholecystitis at Saint Francis Hospital, perforation occurred. Most of these perforations were subacute, with abscess formation.

Perforation should be suspected in the older patient with cholecystitis which is not subsiding within four to six days of onset. Treatment consists of preparation of the patient for surgery, followed by operative drainage, cholecystostomy or cholecystectomy and, rarely, exploration of the common duct. It is never too late or too early to operate in acute cholecystitis.

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Repair of Contractures of the Hand with Pedal Full-Thickness Skin Grafts

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SKIN transplants to the palmar surface of the hand frequently present disappointing results from the standpoint of texture, color and resilience. Diverse types of split and full-thickness skin grafts used in the correction of contracture deformities of the hand have failed to fulfill the desired criteria for good cosmetic and functional restoration.

Split grafts may shrink too readily, and the surface often becomes tenuous and subject to ulceration. Full-thickness grafts, taken from the posterior auricular region as well as the supraclavicular area and the groin, achieve better texture and elasticity in the end result, but certain deficiencies persist. Disadvantages, common to both split-skin and full-thickness transplants to the palm of the hand, include a gradual thickening of the epidermal layer with subsequent pigmentation and desquamation, and the possible presence in the graft of hair follicles which can become keratotic and infected.

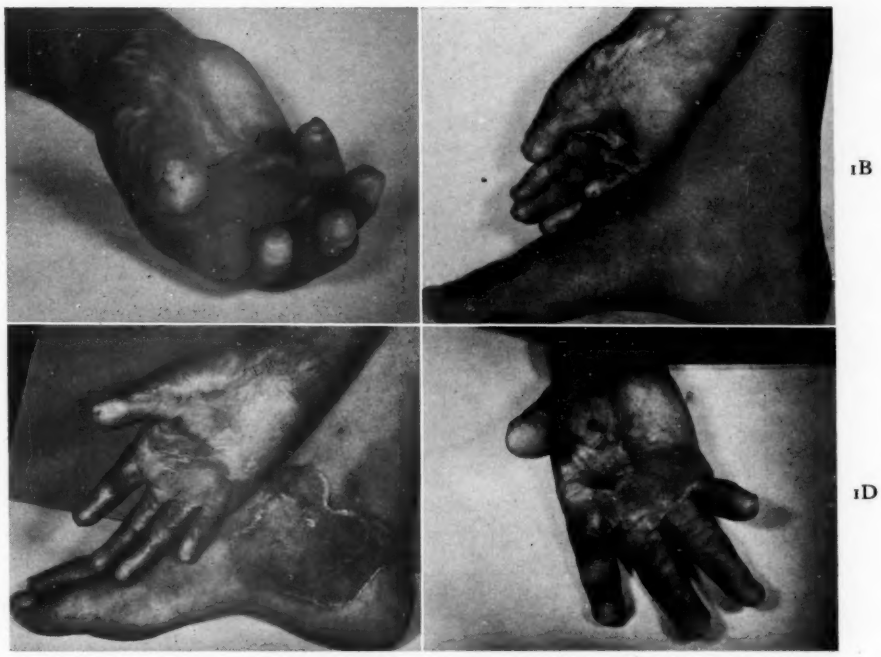
Many authors have described technics pertaining to the specific problems involved in skin-grafting the hands. Bunnel [1] discussed the correction of deep as well as superficial flexion contractures of the hand. May [2] investigated the use of full-thickness grafts in the repair of Dupuytren's as well as cicatricial contractures. George Webster [4] and, later, Trusler, Glanz and Bauer [3] reported their results in the reconstruction of burn scar deformities of the hand, utilizing both split-skin and full-thickness transplants. Jerome Webster [5] was the first person to illustrate the value of the hairless areas of the feet as a source for skin grafts to the hands.

The distinct advantages of the pedal full-thickness skin graft in reparative surgery of the hand appeared especially applicable to the problems encountered locally. In a large percentage of Latin American patients, darker pigmentation of the donor skin effected severe contrasts in color when applied to the palmar surface of the hands. For this reason, a series of pedal transplants to the hand was undertaken with gratifying results.

Full-thickness skin grafts were taken from the hairless region on the medial aspect of the foot. The donor area extends from just below the medial malleolus across the arch to the plantar surface, including, if necessary, part of the non-weight–bearing plantar surface of the foot. In most patients, from the small infant to the adult, the pedal donor site as outlined is adequate to supply skin coverage to the volar surface of the hand without the risk of impeding the permanent function of the foot.

The full-thickness graft is recommended only in definitive surgery of the hand. The autogenous split graft, including little more than the epithelial layer, still gives the greatest diversity as well as assurance of immediate coverage. This type of graft will take satisfactorily in a relatively clean unhealed burn wound and in extensive granulating wounds. Thin grafts will also permit repeated use of the same donor site to accomplish complete coverage when other areas of the body are involved. However, in later reparative surgery, full-thickness skin grafts or pedicle grafts are necessary for a permanent result. In the reconstruction of secondary scar contractures, full-thickness grafts can be employed for durable skin coverage after complete excision of the scar tissue. One may expect the optimum cosmetic and functional result because the entire elastic fibrous layer is included in the transplant and, when properly selected, these grafts manifest the best color as well as texture match.

The preference for a medial pedal full-thickness graft in surgery on the hand is further



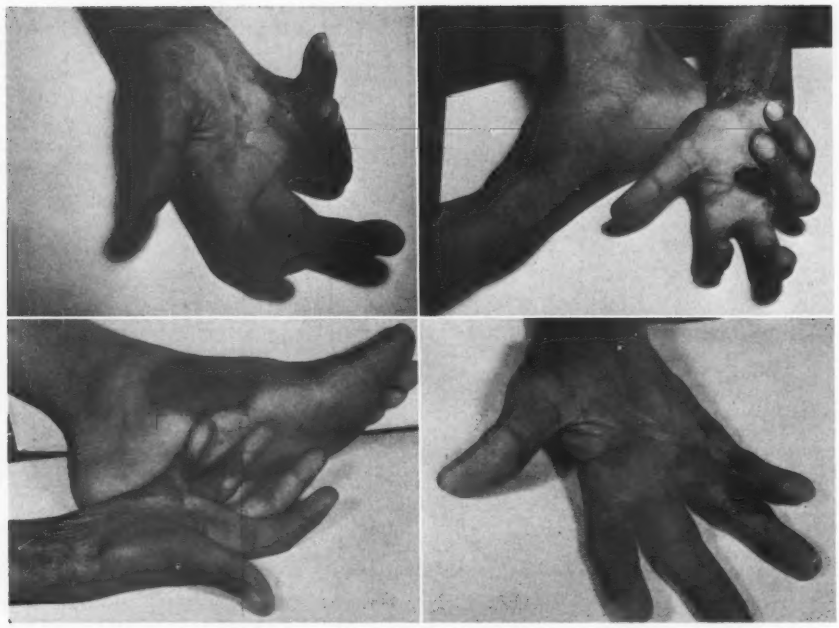
1A 1B 1C 1D

FIG. 1. A, eleven year old Latin American girl with palmar contracture following previous pedicle graft to burn scar of hand. B, hand defect adjacent to pedal donor area. C, three years following application of pedal full-thickness graft to hand and split graft to surgical defect of foot. D, postoperative result of hand repair, three years later, indicating permanence of texture quality, color match and range of motion.

determined by qualities which are intrinsically similar to the palmar skin. The pedal transplant is devoid of sebaceous glands and hair follicles, but does present a normally thick epidermal layer. There are also rugae of the skin surface that form characteristic patterns like those of the palm. Full-thickness grafts of this type consequently give good results in resurfacing the thenar or hypothenar areas of the hand as well as in covering lateral digital donor sites when local pedicle flaps have been used to cover defects of the flexor surface. Previous pedicle flaps of a color which does not match the surrounding skin have also been replaced with pedal grafts to eliminate pigmented hair-bearing areas from the palm of the hand. In the cosmetic selection of a donor site, the medial pedal region has the further advantage of being least conspicuous, and an exposed scarred donor area is avoided.

When a large graft is taken, a split-skin graft is necessary to cover the residual surgical defect of the foot, which will cause some disability and a temporary secondary deformity. However, this has not proved to be a problem in our experience. A split graft is satisfactory to cover the defect and takes well on the primary wound with a minimal amount of after care. Ambulation is allowed within three to five days. With protective padding and an elastic type of dressing, dependency of the extremity has not disturbed permanent healing of the grafted area. Postoperative dressings to the hand are the usual stent type with tie-over sutures, and in almost every case, a full immobilizing splint is applied to the hand.

All the pedal grafts have taken well and, as noted in Figures 1 and 2, the results were favorable. After complete healing had occurred, the texture and color match of the medial pedal transplants were comparable in normalcy and appearance to the volar skin of the hand. In the case illustrated in Figure 2, three types of grafts were applied to the palmar surface for the purpose of visual comparison of end results. In addition to the pedal full-thickness graft to the



2A 2B 2C 2D

FIG. 2. A, nine year old Latin American boy with burn scar contracture of hand primarily repaired with split-skin graft. B, donor site on foot in relation to palmar surface of deformed hand. C, four years postoperatively, following application of three types of transplants in reconstruction of previous contracture. Full-thickness graft from groin applied to hypothenar area, full-thickness pedal graft to center of palm, and split graft from chest to fingers. D, detailed view of postoperative result of hand with different types of grafts approximated for specific contrast with normal palmar appearance. Note intense pigmentation of split-skin grafts over fingers.

center of the palm, a full-thickness graft from the groin was applied to the hypothenar area, and a split graft from the chest was applied to the fingers. The contrasting pigmentation of both the split-skin graft and the full-thickness transplant from the groin with the recipient area is evident in the photographs, and the pigmentation has increased with time.

The success of all skin grafting, particularly with full-thickness transplants, depends upon the preoperative conditions, the surgical technic and postoperative care employed. Full-thickness grafts should be cut to the exact dimensions of the defect with the use of a pattern. Complete and absolute hemostasis in the application of the graft is paramount. The hand should then be immobilized with adequate compression dressings and splinting as necessary.

The first dressing is changed eight to ten days postoperatively. Sutures are removed alternately at the first and subsequent dressings. Protective measures are then taken until the grafted area can be exposed without danger of infection. Lubricants applied to the transplant for a period of time will maintain pliability until the normal elasticity and glandular activity have regenerated.

Finally, functional rehabilitation after surgical repair, particularly in the hand, is essential in completing any reconstructive procedure. Physical and occupational therapy will produce immeasurable improvement in the surgical result. Passive and active motion are also effective, particularly where areas of mobility have been impaired.

SUMMARY

The medial pedal region is a favorable source of hairless skin for full-thickness grafts to the palmar surface of the hand. These transplants have proved to be superior in texture, color match and resilience to other types of full-thickness and split-skin grafts. The principles of skin grafting in general must be followed to

achieve satisfactory results in the restoration of normal appearance and function to the hand following injury.

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Sarcomas Developing in Uterine Fibroids

REVIEW OF THE LITERATURE AND PRESENTATION OF THREE CASES

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LEIOMYOMAS, commonly called fibroids, form the bulk of all human tumors. These tumors will develop and be nourished in twenty to thirty women of every 100 sometime during their lifetime. Some of these growths attain tremendous size and yet patients remain practically asymptomatic except for minor alteration in bowel and bladder habits.

Some reviewers have attempted to formulate the rate of growth of these neoplasms. Putterman [1] quoting Speert suggests the formula R = M/T to determine the approximate rate of growth of fibroids, in which M represents the estimated weight of the tumor and T stands for the time interval in years during which growth occurred. Employing this formula he found the average rate of growth in white women to be about 22 gm. per year and about 67 gm. per year for Negro women. This then, arbitrary as it may be, suggests that the tumors are not only more prevalent in the Negro but that their rate of growth is accelerated.

Despite the natural tendency of fibroids to remain benign, they sometimes undergo fatal transformations. While common benign changes such as hyaline or cystic degeneration, calcification and fatty alterations are of little clinical significance, infection and twisting of a pedicle may give rise to urgent clinical manifestations. Carneous degeneration more often found associated with pregnancy may create an urgent crisis. Willis [2] stated that uterine myomas may be invaded by neighboring neoplasms such as uterine carcinoma and peritoneal deposits of gastric or other cancer. Blood-borne metastases from remote primary growths are occasionally found within myomas, e.g., from cancer of the lungs, melanomas, or mammary cancer.

Of all the changes that myomas of the uterus may undergo, sarcoma is the most subtle and the most deadly. In studies in which the definition between cellular myomas and true sarcomas is clear, the incidence of leiomyosarcoma is less than 1 per cent. Novak [3], Williams [4] and Randall [5] reported the incidence of such changes as 0.52 per cent, 0.26 per cent and 0.19 per cent respectively.

There is a general belief that large tumors are more likely to undergo sarcomatous transformation, especially those occurring in women just before or soon after the menopause. The fifth decade represents the peak incidence of the appearance of the lesion, but no persons are exempt. Whenever a myoma is present there is always the possibility of sarcomatous changes. Until recent years there was a tendency to consider sarcomatous transformations along with degenerative changes, but sarcoma in a fibroid is an entirely new growth. There is nothing degenerative about the power of sarcoma to spread nor its ability to destroy its victim.

Sarcomas of the uterus or in leiomyomas are suspected to be related to previous radiation therapy for benign uterine bleeding. However, the evidence is unconfirmed. Finn [6] in 1950 presented four cases in which radiation therapy had been administered from one to eleven years previously for benign uterine bleeding. This represented 8.3 per cent of his patients with sarcomas and included one endometrial sarcoma, two myomatous sarcomas and another whose type could not be ascertained. Thornton and Carter [7] also presented four cases in which sarcoma developed eleven to fifteen years after intracavitary radiation for benign bleeding. These four cases represented 16 per cent of the number of sarcomas in this series. Similarly, Corscaden [8] found cancer of the cervix and corpus 3.4 times as frequently in women who had had previous radiation therapy as was to

be expected in a comparable group not receiving radiation therapy. Lacassagne was able to produce sarcoma experimentally by exposing inflamed animal tissue to radiation.

Despite these findings, Scheffey [*10*], on the basis of his studies of malignancy of the uterus subsequent to radiation therapy, concluded that omission, either in technic or judgment and not the radiation therapy itself, was the responsible factor in the subsequent occurrence of malignancy.

Others have expressed the view that patients who exhibited the need for radiation therapy to control bleeding were probably already candidates for some form of malignancy. In view of the existing uncertainty some institutions have abandoned or curtailed the use of radiation therapy in the management of benign uterine bleeding.

HISTOLOGY

Leiomyosarcoma may present a varied histologic pattern. Round, spindle or giant cells and intermediate admixture of cell types are the more constant finding. Prognosis depends on the degree of anaplasia of the cells and the number of mitotic figures occupying each microscopic field. Some investigators [*11*] have employed the degree of mitotic activity in the cells as a means of grading the tumor and malignancy trends. At a magnification of about 400, a lesion was considered grade 1 if it contained one mitotic figure per ten to twenty fields of typical tumor tissue, grade 2 if it contained two per ten fields, grade 3 if it contained one to four per field, and grade 4 if it contained more than four per field.

Most pathologists agree with Robert Meyer that the development of a sarcoma from mature muscle cells is quite unlikely but that these tumors may spring from undifferentiated cells persisting in the walls of the myoma or from the connective tissue or blood vessels of the tumor.

SYMPTOMS

There is no dependable behavioral pattern nor orderliness in the development of uterine leiomyosarcoma. This accounts for the uncertainty of its diagnosis prior to surgical removal and microscopic studies. The pertinent findings, such as bleeding, abdominal mass and even pain, are more often associated and attributable to the myoma than to any change it may have undergone. However, unusually rapid growth in a myoma that has been present for some time is a marked sign for suspicion and should alert the clinician to impending trouble. This is especially important when such changes take place after withdrawal of estrogen.

Schiffer and associates [*14*] consider bleeding and an abdominal mass to be the most constant set of symptoms found in the cases they have studied. In eleven of their forty-nine patients, postmenopausal bleeding was the presenting symptom and some form of vaginal bleeding was present in all but five of these patients. The symptoms in order of frequency as found by these authors were: postmenopausal bleeding, irregular bleeding during menstrual life, mass, pain, vaginal discharge and weight loss. It must be emphasized that one cannot wait for pain and loss of weight to present themselves, for then the prognosis is most grave.

DIAGNOSIS

The usual whorl-like appearance of a leiomyoma is completely distorted in regions of malignant changes. Unfortunately, this lesion is rarely diagnosed before surgery has been performed and frequently not until microscopic studies are completed. Twice as unfortunate are those cases that are diagnosed only after local recurrence or distant metastases of the lesion occur. Yet, some investigators suggest that the histologic findings should be confirmed by clinical evidence of rapid growth, infiltration, metastases and recurrence to make the diagnosis foolproof.

Polypoid structures on the cervix or in the cervical canal should be biopsied and studied before hysterectomies are performed. Also curettage performed immediately before removal of the uterus will often indicate the type of surgery required.

Biopsy specimen examined with the frozen-section technic while the operation is in progress is not completely reliable and may lead to serious errors in management. Because a leiomyosarcoma so frequently metastasizes to the lungs, roentgenograms of the chest should be a routine procedure before hysterectomies for tumors are performed.

These tumors go unrecognized at the operating table, and the patient is improperly treated because the surgeon neglected the possibility of their presence. All tumors of the uterus should be opened and examined before the abdomen is closed. In many instances there is confusion

because of the close resemblance and kinship with degenerative processes, especially hyaline changes, with which there may be co-existence.

The external appearance of the tumor may arouse no suspicion whatsoever, although it has been described as more vascular and injected than a purely benign lesion. There may be areas of softening and necrosis, especially marked away from the periphery. Aaro et al. [*11*] has described an irregular or bosselated perimeter with less tendency to separate from the surrounding myometrium than benign fibroids. Cullen was perhaps the first to compare the cut surface of this tumor with that of raw pork [*3*], others liken the resistance encountered to cutting into the tumor to that offered by cutting an unripened pear. With the full development of necrosis the lesion becomes more plutaceous and crumbly, a consistency that is akin to brain tissue.

The incidence of associated malignancies has always intrigued pathologists and confused clinicians. Double primary malignancy is higher in these lesions than chance would dictate. Twenty-seven per cent of the leiomyosarcomas in Webb's [*12*] series were associated with other primary malignancies chiefly adenocarcinoma of the endometrium, cervix, or ovary.

Greene and Gerbie [*13*] called attention to the close resemblance hemangiopericytoma bears to true sarcoma and to the danger of confusing the two lesions. This distinction is imperative because the prognosis is vastly more encouraging in cases of the former.

TREATMENT

Surgery offers the best hope for survival in the management of leiomyosarcomas of the uterus. The uterus, cervix, ovaries and tubes should be removed. When less than this is done there is grave danger of recurrence and the need for further therapy. In younger persons, such as one of our patients, this may be a somewhat radical and painful decision to make. However, it must be done for the consequences of incomplete removal are disastrous. Over the past thirty to forty years the treatment of this lesion has varied. Therapy included radium implantations, x-ray therapy, myomectomy, subtotal hysterectomy and even modified Wertheim procedures. All of these give less satisfactory results than complete removal of the generative organs. Since sarcoma is insensitive to radiation and does not affect the regional lymph nodes ordinarily, postoperative radiation therapy is of questionable value.

PROGNOSIS

In general prognosis is poor. Probably no more than *15* to 20 per cent of patients have a five-year survival salvage. The salvage will vary depending to a large extent upon the cellular variation of the lesion and whether or not the delineation between cellular myoma and low grade sarcoma had been accurately ascertained.

The management of the retained cervix in instances in which subtotal hysterectomy had been performed is a vexing and irksome problem. If the number of mitotic figures indicates a highly malignant growth it is far better to go back and extirpate the remaining cervix. If the lesion appears to be of a low grade malignancy one may decide to do nothing more than watchful observation.

Recurrence manifesting itself in lung metastasis requires pneumonectomy for complete removal. In 1930 Torek [*15*] successfully removed a metastatic adenocanthoma of the lung almost three years following total hysterectomy for the original neoplasm. Lilienthal [*16*] in 1933 presented a case of pneumonectomy of the left lung for a neoplasm following sarcoma of the uterus. Davis et al. [*17*] presented a case of total pneumonectomy in a sixty-one year old woman who had undergone subtotal hysterectomy for leiomyosarcoma eleven years earlier. The danger of recurrence is ever present in this treacherous disease.

The three cases presented herein have all been treated during the past nine years in the private practice of one of us (H. G. B.).

CASE REPORTS

CASE 1. The patient, a forty-eight year old woman, was seen in July 1950. She complained of lower abdominal and lumbosacral pain together with vaginal spotting and a weight loss of 30 pounds during the six months preceding consultation.

The significant findings of the past history were as follows: she had never been pregnant, had excellent health until the menopause began when she was forty-five years of age when bleeding tumors necessitated hysterectomy. Subsequent investigation revealed that the operation, a subtotal hysterectomy performed in another city, had revealed leiomyosarcoma as an unexpected microscopic finding. Subtotal hysterectomy should never be performed. The patient had had no follow-up care and

had disappeared from observation until we saw her three years later.

The pertinent findings in the present illness were concerned principally with the pelvis and its environs. She showed evidences of weight loss, chronic anemia and appeared acutely ill. Laboratory findings supported this clinical impression. Radiographic studies of the chest and bones of the pelvis revealed nothing of undue significance.

The abdomen was scaphoid and tender to deep palpation and there was the suggestion of a deep mass in the pelvis in the left lower quadrant.

The external genitalia and perineum added nothing of clinical importance. The vagina appeared shortened and less resilient than is normally found in persons of this age. The cervical stump looked boggy and edematous and bled when manipulated with accompanying pain. Rectovaginal examination showed no changes in the parametria or in the septum but a hard, elongated, painful, immobile mass could be felt in the cul-de-sac. Subsequent studies revealed leiomyosarcoma both of the stump and mass in the cul-de-sac.

The patient's condition deteriorated so rapidly that contemplated radiation treatment could not be given. She was given only supportive treatment before she died two weeks after coming under our care, and a little over three years after undergoing subtotal hysterectomy for what were thought to be benign myomas.

Case II. This patient, a thirty-one year old woman, Para 0, gravida 0, underwent myomectomy in 1954 as an elective procedure for the removal of myomas thought to be partly responsible for her sterility. Six myomas measuring from 1.5 to 7.6 cm. in diameter were removed from the anterior and posterior surfaces of a uterus that was enlarged to the size of a three and a half month gestation before operation.

There was no inkling of malignancy in any of the myomas until microscopic studies demonstrated leiomyosarcoma in the next to the largest myoma. This myoma measured 4 by 3 by 2.5 cm. and contained an area of slow growing low grade sarcoma cells. The capsule of the tumor appeared intact.

Although this patient never became pregnant, nearly five years following operation she has had no demonstrable metastasis and enjoys good health.

Case III. A twenty-nine year old married woman, Para 0, gravida 0, came to the hospital in January 1956 because of enlargement of the abdomen, fullness in the vagina and irregular vaginal bleeding of six weeks' duration. She appeared anemic but was well developed and not acutely ill.

Family history was not germane to this study. She knew she had a tumor of the uterus for over two years, and for the past six months pain and discomfort curtailed marital relationship.

She began menstruating at the age of eleven, the periods coming regularly every twenty-eight days and lasting three to four days. Cramp-like lower abdominal pain, not sufficiently severe to require bed rest preceded and accompanied the flow for the first thirty-six hours. The pattern of bleeding was irregular for the eight-month period that preceded her coming to us. Constant shortening of the cycle was the chief feature of irregular menstrual behavior.

The meaningful findings in her examination were confined to the abdomen, pelvis and vagina. The abdomen was slightly obese, exhibiting a smooth, globular, moderately tender, freely movable mass in the midline, 2 cm. above the symphysis. Pressure on the suprapubic mass elicited vaginal discomfort.

The external genitalia and perineum were normal. The examining finger could enter the vagina for a depth of only 4 cm. before encountering a firmly fixed, hard, tender mass. The tumor fitted the vagina so snugly there was no intervening space between tumor and vaginal wall. It was impossible to introduce a speculum for inspection. Exposure obtained by employment of the index and middle fingers of both hands showed dark blood trickling down from above the tumor and bathing the shallow distal vaginal wall. Apprehension prevented the patient's full cooperation. Pressure on the vaginal tumor failed to produce any motion in the suprapubic mass. The rectum, parametria and uterosacral ligaments were apparently normal.

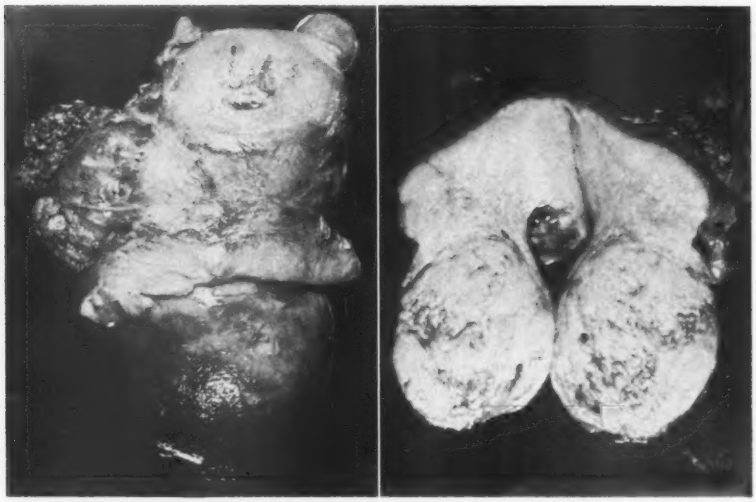
Laboratory examination showed the following: red blood cells, 2,500,000 per cu. mm.; white blood count, 7,200 per cu. mm.; hemoglobin, 7.2 gm. per cent, segmented neutrophils 51 per cent, lymphocytes 47 per cent, monocytes and eosinphils 1 per cent each. Blood chemistry and urinalysis were normal. Blood type was A, Rh positive. Hematocrit was 28 per cent.

Papanicolaou test made directly from the secretions between the fourchette and the tumor (there was no vaginal pool) failed to reveal malignant cells.

X-ray findings of the chest were normal. Films of the abdomen revealed a tumor mass in the pelvis depressing the urinary bladder. Barium enema studies and cystoscopic examination were normal but for depression of the bladder and compression of the rectum by tumor mass.

After receiving 2 units of whole blood and other supportive treatments, the patient was considered ready for elective surgery five days after admission to the hospital.

With the patient under spinal anesthesia the abdomen was entered through a left paramedian incision. A tumor about the size of a fourteen weeks' gestation presented itself for examination. There



1A 1B

FIG. 1. A, uterus showing pedunculated vaginal mass with central necrosis and fungating adnexal mass on the left side. B, entire tumor is open showing broad base of the prolapsed submucous growth.

was a subserous 3.5 cm. tumor to the right side of the fundus and to the left side a fungating hemorrhagic mass extended from the left broad ligament and appeared to be clinging to the cornu of the uterus. (Figs. 1A and B.) This seemingly adventitious growth measured about 6 cm. in diameter. While the thickened, bulging, hemorrhagic, necrotic proximal portion of the broad ligament mimicked an infected cyst, the lateral section appeared normal. The tube appeared surrounded but not grossly involved in the tumefaction.

There was about 15 cu. cm. of blood-tinged fluid in the peritoneal cavity. A small segment of the omentum was attached loosely to the fundus of the uterus and the left tumor mass. Beyond these attachments the omentum appeared normal. There were no palpable glandular enlargements anywhere in the pelvis or along the aorta. The liver, spleen and kidneys appeared normal. The findings were so disturbing and suggestive of malignancy that complete extirpation of uterus, tubes and ovaries was considered the treatment of choice.

The tightly fitting vaginal section of the mass added to the difficulties of mobilization of the whole tumor. Splitting the vagina and part of the rectovaginal septum made the task easier. With this accomplished the removal of the organs was concluded in stepwise fashion. The vagina and septum were repaired in layers before the other reconstructive steps of the operation. Because of the necessity of removing a vaginal tumor abdominally, the patient was given antibiotics some days before surgery and the area of operation protected as best we could. Our fears were partially confirmed when the pathologist called in a few hours to give the presumptive diagnosis of sarcoma which was later verified by microscopy. The patient was discharged on the tenth postoperative day after an uneventful postoperative course.

Pathologic report was as follows: the specimen submitted consisted of a totally removed uterus 18 by 13.5 by 8 cm. in its greatest dimensions. Protruding from the widely opened, thinned out gaping cervix was a bell-like mass extending in a bell-clapper fashion. There was a fungating and softened area near the distal extremity of this tumor. This protruding oval mass measured 10 by 10 by 6 cm. There was also a subserous fibroid measuring 3.5 cm. on the right fundic area. A cauliflowered, hemorrhagic mass measuring 6 by 4 by 2.5 cm. was impinging on the left cornual area in the region where the tube and ovary should have been.

Hemisection of the uterus showed that the bell-clapper mass previously described was attached by a broad base that measured 5 cm. to the fundus of the uterus. On cross section, the bell-clapper mass was soft to palpation and showed frequent plutaceous hemorrhagic areas with the consistency of brain tissue. Also submitted separately were two tubes and ovaries. The left ovary revealed small cystic areas, but otherwise these structures were quite normal.

Microscopic studies of multiple sections taken

from the bell-clapper tumor showed cellular sheets of large, plump cells and many double nuclei. The cells were interlacing and pointed in all directions. Mitoses were infrequent.

Section of a lateral grape-like fungating cluster attached to the left broad ligament and uterus showed the same architecture. These cells showed hyperchromatism and loss of nucleus-nucleolus ratio. Studies made on various other areas of the uterus failed to show similar changes.

The ovaries showed stroma about follicle cysts and corpus luteum. Tubes showed no unusual features. Endometrium was compressed. The diagnosis was a slow growing leiomyosarcoma uteri, cystic ovaries and normal tubes. The patient returned to work ten weeks after operation. She is still doing well almost three years after surgery.

COMMENTS

Each of the three cases in this presentation portrays a peculiar feature of leiomyosarcoma of the uterus. In the first case recurrence and death followed because the correct diagnosis had not been made at the operating table, and the microscopic findings were not correlated with the patient's future management. She later manifested recurrence in the cervical stump and the pelvis. This is an example of what many writers in the past were in the habit of calling a "recurrent or metastasing fibroid." The patient eventually died from the effects of these lesions.

At the time of this writing, it is five years since the second patient underwent elective myomectomy for multiple myomas of the uterus. The microscopic findings of sarcoma within the confining capsule of a small myoma have so far given a better survival rate. The prognosis appears better when the tumor is well blockaded in a small myoma with a strong unbroken capsule.

The third case is still too fresh to talk of survival and prognosis. This case presents many confusing aspects. The extension of sarcoma as we understand it is principally by the blood or lymph streams and by direct continuity in order of decreasing frequency. Randall believes that the prognosis depends more on the extent of the lesion when adequate treatment is given and that the histologic picture is of secondary importance.

When hematogenous spread has taken place the lungs are usually the first to become involved and next the liver and brain. Up to now we have been unable to find any area of metastasis that could be ascribed to the blood stream or otherwise.

Lymphatic drainage from the lower uterine segment follows much the same pattern as lesions of the cervix and upper vagina. Javert [*18*] has recently demonstrated that the lymphatic systems of the uterine cervix and fundus intermingle in such a way that both prograde and retrograde flow is possible to the adjacent organs and nodes.

Often lymph channels will detour around certain nodes and regions and empty into those above. This being so, it becomes increasingly difficult to determine whether the sarcoma of the prolapsed myoma bypasses the intervening areas and attacks the left cornual region and broad ligament, or vice versa. It is significant that the areas between the two lesions were sarcoma-free despite long and patient search for such cells in the study of dozens of sections.

There is a possibility that these lesions may represent multiple areas of origin. In short, two widely separated areas of myomatous tissue responded to the malignant impulse. The decision in this case must be left to wiser heads.

Our only source of comfort for the moment is that the patient is doing well. We have not given her radiation therapy for two reasons: first, we are not convinced that there is anything to gain from its use; and second, she is so markedly apprehensive, radiation therapy may further trigger her expectation of impending doom.

CONCLUSION

The overwhelming tendency of fibroid tumors to remain benign should not prevent one from thinking of, recognizing, treating adequately and observing carefully the malignant lesions that are capable of development within these growths.

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Recurrent Dislocation of the Shoulder

TEN YEARS' EXPERIENCE WITH THE PUTTI-PLATT RECONSTRUCTION PROCEDURE

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RECURRENT or habitual dislocation of the shoulder joint is a condition which is commonly seen in young athletic males. This explains the frequency with which it is encountered in the military service, and the military surgeon is called upon to institute operative correction in a large number of patients. This has afforded an unusual opportunity for the study of a greater number of patients than is ordinarily available to the civilian surgeon. Since the etiology, pathogenesis and most effective type of operative treatment of this condition are still subjects of considerable dispute, a review of a section of Army experience may be of value.

MATERIAL

During the ten-year period between January 1, 1949 and December 31, 1958, my associates and I, in a group of four Army hospitals, performed 117 reconstruction procedures for the correction of recurrent dislocation of the shoulder. All the operations were carried out according to the technic used individually by Vittorio Putti and Sir Harry Platt, and reported by Osmond-Clarke [*21*]. Thirty-eight of the operations were performed according to the original operative technic. Seventy-nine patients were treated by a simplified version of the Putti-Platt procedure which I originally described with Jeffress in 1952 [*5*] and again in greater detail in 1955 [*6*]. The original and simplified operative technics have been adequately described elsewhere [*5,6,21*] and need not be repeated here. The basic principle of the Putti-Platt procedure is an individual plication of the subscapularis muscle and the anterior capsule, resulting in a tightened anterior support to the humeral head and slight residual limitation of external rotation of the shoulder.

SELECTION OF PATIENTS

Only those patients with a significant degree of disability were subjected to surgical repair. Inability to perform ordinary activities or to engage in simple athletics without dislocation or fear of dislocation were the usual criteria. Patients who could get along with their difficulty without significant disability were not operated upon. Only those persons who had multiple recurrences without severe trauma were considered for surgery. All patients had had at least three dislocations before operative reconstruction was considered justified.

From the strictly military point of view, a recurrent dislocation of the shoulder which originally occurred prior to induction is not ordinarily considered for reconstructive surgery unless the patient has had an additional injury in the Service which has aggravated the preexisting condition. Many of these persons can get along quite well with a limited assignment of duty, and surgery in the Service should be considered only if there is definite evidence that the disability is connected with the Service. If there is no connection and if the condition is considered disabling for even limited duty, discharge for disability should be considered, since any operative reconstruction may be followed by what has now become a disability connected with the Service, which may be even greater than that which existed before operation. In most cases the decision is not difficult because there is either an original or a definite aggravating injury in the Service and the patient is obviously unfit for duty in his existing physical condition. Furthermore, the patient is very desirous of operative intervention and the

presently accepted types of operative repair afford a favorable outlook for satisfactory correction and an early return to military activity, with only a short period of duty limitation.

ANATOMIC CONSIDERATIONS

The shoulder joint is weakly constructed and is the joint most subject to dislocation. The glenoid fossa is shallow, and the head of the humerus is so large in proportion to the glenoid cavity that no more than one-fourth of the head is ever in contact with the glenoid. The joint capsule is lax in order to permit extreme degrees of shoulder rotation. It provides little anterior support either to the humeral head or to the triangular, cartilaginous glenoid labrum which surrounds the edge of the glenoid and slightly deepens the glenoid cavity. Anterior glenohumeral ligaments are present but are anatomically weak. There may be an enlargement of the intracapsular space by an anomalous opening into the adjacent subscapularis bursa. A continual downward and inward pull is exerted on the humeral head by the pectoralis major and latissimus dorsi muscles. This is often stronger than the retentive effect of the subscapularis and the muscles of the external rotator cuff. All these factors, together with the frequent presence of bony, cartilaginous and muscular developmental anomalies, make the shoulder joint extremely unstable.

PATHOGENESIS

It is commonly believed that there is no single cause of recurrent dislocation of the shoulder, no single pathologic finding which may be considered the "typical defect," and no single reconstructive procedure which is accepted above all others as the operation of choice. Various mechanical causes of dislocation and of recurrence have been postulated [*1,9*]. The principal pathologic findings have been repeatedly demonstrated, and the effectiveness of different types of reconstructive operative procedure has been well documented. However, the relationship between cause and effect in the pathogenesis of recurrent dislocation is frequently not clear, and the actual mechanism of correction by the various reconstructive procedures remains for the most part controversial.

There are three principal theories concerning the etiology of recurrent dislocation. One is that the condition follows a dislocation of the shoulder resulting from the usual abduction, external rotation type of injury, which has healed improperly due possibly to an inadequate period of immobilization. Another theory, proposed by Bankart [*2*], is that the original dislocation is the result of a direct forward thrust of the humeral head against the glenoid labrum with separation of the latter structure and its attached capsule from the glenoid rim. In this type of injury it is suggested that the cartilaginous labrum does not heal properly and remains detached from the bone. The anterior support of the head is reduced, the capsule becomes even more than ordinarily lax, and repeated dislocation is therefore facilitated. The third theory is that a developmental anatomic defect or a neuromuscular imbalance [*8*] which permits abnormal shoulder movement exists. This theory is supported by the frequency of the condition in epileptics, the frequency of bilateral dislocation, the familial tendency, and the fact that recurrent dislocation occurs not infrequently without any severe initial trauma.

There are three principal pathologic changes which are commonly noted in recurrent dislocation of the shoulder [*3*]. The so-called "Bankart lesion" is a degeneration with partial or complete separation of the anterior and inferior portions of the glenoid labrum from the bony glenoid margin. Along with this, there is a stripping of the attachment of the capsule from the anterior surface of the neck of the scapula. The severity of this depends on the degree of separation and degeneration of the cartilaginous labrum. In the posterior surface of the articular portion of the humeral head, there is usually a notched cartilaginous and bony defect which has been shown to fit into the inferior glenoid rim upon wide abduction and external rotation of the shoulder. All these findings were clearly described by Broca and Hartmann [*7*] in 1890 and have been corroborated by numerous observers. Whether they represent the cause or effect of the recurrences remains uncertain, but their presence undoubtedly reduces the stability of the shoulder joint and favors dislocation.

In addition to these three common findings there are others which are noted less frequently. Anomalies of the insertion and development of the subscapularis muscle are occasionally present. Flattening of the glenoid cavity with lack

FIG. 1. Anteroposterior roentgenogram showing compression fracture of humeral head associated with traumatic dislocation. This develops into "notched defect" which decreases stability of joint and becomes more marked with recurrent dislocations.

FIG. 2. Anteroposterior roentgenogram of patient with recurrent anterior dislocation of shoulder showing defect in posterior portion of humeral head demonstrated in position of 45 degrees' abduction and 60 degrees' internal rotation. There was no severe injury and dislocations were always spontaneous, suggesting a congenital defect.

of development of its anterior margin is sometimes seen. The anterior margin may be roughened, proliferated or loosely attached. Free osteocartilaginous bodies are occasionally noted within the joint. Definite unhealed tears of the capsule are infrequent. An associated defect in the external rotator tendinous cuff has been reported by some observers.

CLINICAL AND RADIOLOGIC FINDINGS

The usual patient with recurrent dislocation of the shoulder presents no gross abnormal physical findings. Good shoulder musculature is the rule. Occasionally the patient can voluntarily produce a dislocation by abduction and external rotation, but this is not ordinarily possible. In certain persons, the examiner may demonstrate a downward subluxation of the humeral head which can be produced by vertical traction on the upper extremity. This is apparently due to unusual laxity of the capsule. Subluxation can be prevented if the patient flexes his elbow and resists the downward pull by muscular action. It should be noted that this type of subluxation is usually not disabling. If operative correction is required, it will not be accomplished by the usual procedures which limit external rotation and reinforce the anterior glenoid rim.

In recurrent dislocation, the displacement usually has been corrected by the patient himself before roentgenograms can be made. Radiologic evidence of recurrent dislocation may often be demonstrated by a notched defect in the posterior portion of the articular surface of the humeral head. This may be accompanied by bone condensation adjacent to the notch, which produces a vertical line of sclerosis. These radiologic findings have been described in detail by Hill and Sachs [*16*], and are thought to be due to a compression fracture occurring at the time of the initial injury. The notch deepens at each subsequent dislocation due to pressure of the humeral head on the glenoid rim. (Fig. 1.) There is little evidence to support the theory that the notch is congenital or developmental in origin. Other radiologic changes which may occur are cystic lesions in the head, lipping of the glenoid margin and loose body formation.

In order to demonstrate the bony defect which is usually present in the posterior surface of the humeral head, it is advisable [*4*] to take both anteroposterior and axillary views of the shoulder joint in the position of 45 degrees' abduction and 60 degrees' internal rotation. In this position the notched defect, if present, can best be demonstrated. (Fig. 2.)

Care should always be taken to be certain that dislocation actually occurs. An attempt should be made to obtain a roentgenogram with the head displaced. In such cases an axillary view will demonstrate whether the dislocation is anterior or posterior. This may usually be determined clinically by carefully noting the direction of the displacement of the humeral head at the time of dislocation, provided the patient can be examined before the dislocation has been reduced. Posterior displacement [*19, 20,24,28*], which occurs in 2 to 3.8 per cent of all shoulder dislocations, may easily be overlooked

by the unwary. When this condition exists, the ordinary reconstructive procedures applied to the anterior joint structures will not prevent dislocation. Failure to make the proper diagnosis may account for some of the recurrences which have followed operative repair.

STATISTICAL STUDY

Detailed questionnaires were sent to patients on whom operative procedures had been performed at least two years previously. The replies furnished adequate information for determining the success of the procedure, the patient's opinion of the result, and the degree of disability which persisted. The reports of 117 operative procedures provided exact information regarding the pathologic findings.

Age and Sex. Of the patients who returned the questionnaire, there were seventy-seven males and one female. The oldest was forty-one years of age and the youngest was eighteen, the average age being 23.6 years.

Side of Lesion. Forty-three operations were on the left side and thirty-seven on the right side. Two patients had an operation on each shoulder.

Bilateral Complaints. Of the group of seventy-eight patients, there were bilateral complaints in fifteen (19.2 per cent). In addition to the two patients in our series who had bilateral operations, four other patients had had previous operations on the opposite shoulder. One underwent a successful Nicola procedure. There were two who had Bankart operations, and one of these was followed by recurrence. One patient had two unsuccessful operations, first a Nicola procedure and then a Bankart repair. Nine patients did not have sufficient difficulty with the opposite shoulder to justify surgery.

Familial History. A history of recurrent dislocation of the shoulder in other members of the family was given by only two patients (2.6 per cent).

Previous Operations. Four of our patients had had unsuccessful operations performed on the shoulder elsewhere before we operated on them. Of these, two had satisfactory results from our operative procedure. Three had Putti-Platt procedures. One of these was again followed by recurrence and the other two produced successful results. A previously unsuccessful Nicola procedure was also one of our failures. It occurred to us that the failure of these two repeated operations might be due either to the presence of an unrecognized posterior dislocation or to an unusually redundant capsule which permitted downward subluxation of the shoulder. The latter situation was definitely established in one of these patients who later was subjected to arthrodesis of the shoulder.

Handedness. It has been suggested that there is a tendency for dislocation to recur on the side opposite the dominant extremity. This may be due to a lesser degree of muscular development and coordination. In eighty-two patients we had knowledge of the dominant extremity. Seventy-one of these were right-handed. There was dislocation of the left shoulder in thirty-six (60.0 per cent) and of the right shoulder in twenty-four. Eleven patients had bilateral dislocations. Eleven patients were left-handed. There was dislocation of the right shoulder in eight patients (88.8 per cent) and in the left shoulder in only one. Two had bilateral dislocations.

History of Trauma. Among the eighty patients with dislocations of the shoulder, sixty-three gave a definite history of an original trauma severe enough to cause the dislocation. However, seventeen patients (21.3 per cent) reported that the original dislocation as well as the succeeding ones were caused by some simple shoulder movement, such as sweeping, painting, reaching overhead, swimming, diving or a swinging movement in boxing without coming in contact with an opponent. The original dislocation occurred as the result of an epileptic seizure in only two patients (2.5 per cent).

Original Treatment. The treatment of the original dislocation was by fixation to the side of the body in twenty-four cases, but only a sling or no immobilization whatsoever was used in treating fifty-six (70.0 per cent) of the patients.

Duration of Original Treatment. Immobilization of the shoulder at the time of original injury was maintained for over two weeks in only eighteen patients. In sixty-two (77.5 per cent), there was either no immobilization or it was maintained for two weeks or less.

Operative Complications. Of the 117 reconstructive procedures, there were two wound infections, three patients required postoperative manipulation under anesthesia because of residual stiffness in the shoulder, and one pa-

tient had a temporary partial paralysis in the musculocutaneous nerve distribution.

Pathologic Findings. Of the 117 operative procedures, there were fifteen (12.0 per cent) in which no significant separation of the glenoid labrum or capsule could be found. In the remainder the "Bankart lesion" was well demonstrated. In nine patients there were loose intra-articular bodies, and six had a large opening anteriorly between the capsule and the subscapularis bursa. In four patients there were anomalies of the glenoid cavity. Two had anomalies of the subscapularis muscle. A tear in the anterior capsule was noted in only two. One patient who had a glenoid anomaly also had a loose coracoid process. Only fifty-eight defects of the humeral head (49.6 per cent) were noted by the surgeons in the entire series. This incidence is considered to be extremely low and is probably due to the failure of the operator either to search for the defect or to report it in his operative findings.

Operative Results. Of the 115 patients who had operative procedures, there have been 109 in whom the postoperative time is long enough to justify an estimation of the end results. Seventy-eight of these patients (71.6 per cent) returned the completed questionnaires. It may be argued that a two-year postoperative period is not long enough for proper evaluation and that there may be recurrences after this period. However, if there is to be further habitual dislocation, it will probably occur within the two-year postoperative period.

Recurrence. Six of our operative procedures were followed by recurrence of the dislocation (7.5 per cent). With the original Putti-Platt technic there were two recurrences among twenty-seven operations (7.4 per cent). With the simplified technic, four recurrences occurred among fifty-three patients (7.6 per cent). An evaluation of the failures did not furnish any clue as to the cause of the recurrence. Severe injury was the inciting cause in only one patient. All the patients who had postoperative recurrences reported some residual limitation of shoulder motion. Therefore, it was not a failure to produce operative limitation of external rotation which was to blame. Five patients simply stated that there was recurrence without severe injury and that the operation was not successful, although one of them reported no serious disability and was satisfied with the result.

Sensation of Instability. Although they gave no history of recurrence, thirty-four patients had the sensation of instability of the shoulder and were apprehensive concerning the possibility of further difficulty.

Pain, Stiffness and Weakness. Fourteen patients had some residual painful sensation in the operated shoulder, and twenty-three had some subjective stiffness, although it was not severe enough to limit ordinary activity. Thirty-five patients reported their inability to engage freely in athletic activity although mild non-contact athletics could be enjoyed by all patients whose dislocation did not recur. Fear of possible dislocation was often the cause of the limited activity. Thirty-one patients felt that there was some residual weakness of the shoulder.

Patients' Estimation of Results. After seventy-six of the operations (95.0 per cent), the patients expressed satisfaction with their results. We considered one of these an operative failure because there was a reported recurrence. Sixty-six (82.5 per cent) were classified as excellent or good, ten (12.5 per cent) as fair and four (5.0 per cent) as poor. Eight patients stated that they would not recommend the operation to others with recurrent dislocation of the shoulder. We considered three of these successful operations, but the patients objected to the residual limitation of shoulder motion which precluded unrestricted participation in athletics.

COMMENTS

A very large percentage of our patients with recurrent dislocation of the shoulder gave a history of inadequate immobilization at the time of the original dislocation. It would seem reasonable that fixation to the side of the body for a minimal period of four weeks would decrease, at least to some extent, the likelihood of repeated difficulty. However, it is probably true (as pointed out by other observers) that the more severe the original trauma the more complete will be the healing process and the smaller the incidence of recurrence, provided there is adequate immobilization. Conversely, it may also be true that recurrence is to be expected with or without adequate treatment when a shoulder originally dislocates in the absence of severe trauma. The higher incidence of recurrence in young persons, notably in the second and third decades, as compared with

TABLE I
RESULTS OF OPERATIVE PROCEDURES

Author and Year Reported	Operation Used	No. of Patients	No. of Recurrences	Per cent Recurrences
Giannestras, 1948	Magnuson	31	2	6.4
De Palma, 1950	Magnuson	23	2	8.7
Vare, 1953	Magnuson	30	0	0
Gartland and Dowling, 1954	Magnuson	19	2	10.5
Robertson, 1954	Magnuson	14	0	0
Adams, 1948	Nicola	59	21	35.6
Rowe, 1956	Nicola	32	17	53.0
Adams, 1948	Bankart	18	1	5.5
Townley, 1950	Bankart	26	0	0
Rowe, 1956	Bankart	75	1	1.3
MacAusland, 1956	Bankart	13	0	0
DuToit and Roux, 1956	Bankart (Johannesburg stapling)	150	7	4.7
Dickson and Devas, 1957	Bankart	50	2	4.0
Palmer and Widen, 1948	Bone block	60	4	6.6
Gallie and LeMesurier, 1948	Fascial repair	175	7	4.0
Adams, 1948	Putti-Platt	37	2	5.4
Severin, 1953	Putti-Platt	16	1	6.3
Present series, 1960	Putti-Platt	80	6	7.5

older patients, regardless of original treatment, has been well documented [*24*].

One cannot fail to be impressed by the high incidence of bilateral dislocations, the occurrence in epileptics and the large number of cases in which the original dislocation occurred without severe trauma. These factors strongly suggest that there may be a developmental defect in the structure of the shoulder joint or inadequate neuromuscular coordination as the basis for recurrent dislocation. The greater incidence of recurrent dislocation on the side opposite the dominant extremity also suggests inadequate muscle strength or coordination as an etiologic factor.

The Putti-Platt operative procedure provides a percentage of satisfactory end results which compare favorably with those reported with other methods. Table I represents some of the end results reported by other observers using various methods of shoulder reconstruction. The effectiveness of the Putti-Platt procedure is apparently not due entirely to the slight loss of external rotation which it produces, but rather to the anterior scarring and the increased resistance provided for the humeral head by the tightened capsule and subscapularis muscle. Our evaluation of postoperative recurrences did not reveal they were due to failure to limit external rotation.

The Putti-Platt reconstruction procedure presents no major technical difficulties and does not require the use of special surgical instruments. It is readily available to the average surgeon in whose hands it offers a greater likelihood of a successful result than the employment of more complicated procedures. The operation is effective in any anterior recurrent dislocation regardless of the existing pathology. When posterior dislocation is present, the technic of posterior reconstruction advocated by Severin [*25*] or the subscapularis check procedure described by McLaughlin [*19*] will be appropriate.

The simplified Putti-Platt technic which we have employed reduces the size of the incision and the operating time, minimizes operative trauma, and shortens the period of postoperative rehabilitation. Our results with this method have been as satisfactory as with the original technic. We now use the simplified technic in ordinary dislocations, reserving the original method for patients in whom there have been previous operative failures or where bony, capsular or muscular anomalies require an added degree of security through greater limitation of external rotation.

It is advisable to withhold operative repair for thirty days following any complete dislocation of the shoulder. This is due to the fact that

hemorrhagic infiltration of the capsule, resulting in increased tissue friability, may prevent adequate capsular plication and so jeopardize the end result.

Postoperative treatment includes immobilization in the Velpeau position for four weeks with the original technic and three weeks with the simplified method. Static shrugging of the deltoid and biceps muscles is begun after ten days. When the "cross chest" position is discontinued, a sling is used for one week, during which time pendulum and active shoulder exercises are instituted. At the end of three or four weeks of this treatment the patient may be discharged. There is always residual limitation of at least 20 degrees of external rotation at this time but function is not significantly impaired. Patients are warned to protect their shoulders and are instructed to avoid contact athletics for a full year, although swimming and other mild athletic activities are permitted. Patients in the military service are given limited duty for a period of two months, with avoidance of all activity requiring strenuous use of the operated extremity. Thereafter, full duty is ordinarily permitted.

SUMMARY

1. A group of 117 recurrent dislocations of the shoulder treated by the Putti-Platt reconstruction procedure is reported.

2. Follow-up studies of eighty reconstructions at a minimal two-year postoperative period reveals a recurrence rate of 7.5 per cent.

3. The operative procedure is not technically difficult, requires no special instruments and should be effective in the hands of the average trained surgeon, regardless of the pathologic changes which are present.

4. Initial dislocations of the shoulder should be completely immobilized in adduction for a period of four weeks in order to minimize the incidence of recurrence.

5. The selection of patients for reconstruction of the shoulder is discussed. The importance of recognizing the existence of recurrent posterior dislocation or a downward subluxation of the humeral head is emphasized, since these entities are not corrected by the Putti-Platt procedure for anterior reconstruction of the shoulder.

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The So-called Hepatorenal Syndrome

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THE so-called hepatorenal syndrome is a pathologic entity causing great controversy. Its clinical symptoms are precisely described, and some experimental research has been done, but nevertheless its existence is doubtful.

HISTORICAL

The hepatorenal syndrome is associated with the names of Lancelot (1882) and Ricardiere (1890).

The syndrome was referred to in every case of acute renal failure with pre-existing hepatic disease, even if this was only a coincidence. It was Furtwaenger (1927) who first reported a case of fatal renal failure which occurred after a traumatic lesion of the left lobe of the liver with a tear which caused its partial necrosis. Hellwig et al. (1932) reported a similar case.

Colp and Ginsburg (1937) reported a series of seven questionable "renal deaths" in 130 operations on the bile system. The most striking feature found at autopsy was consistent with necrosis of the liver due to artery ligation.

At the same time, many reports (which are sometimes very inaccurate) appear under the name of hepatorenal syndrome (Lenner, Ellis and Malec). It seems that every case of renal failure in a person with liver tissue damage was referred to as the hepatorenal syndrome. Nonnebruch [*17*] (1939) and Heÿd [*12*] (1940) summed up the features of this syndrome as liver necrosis and acute functional failure of the kidneys.

Nell [*16*] differentiates the syndrome of renal failure due to drainage of the biliary system. This was an attempt to create a new clinical entity with definite symptoms and a known cause.

The accidental ligation of a final branch of the hepatic artery is not rare. Haberer reported the first case. Graham and Cannel [*10*] (1933) reported twenty-seven accidental ligations of the main trunk of the hepatic artery (sixteen of these were fatal) and this is a very incomplete list. The ligation of smaller final branches must be a much more common complication, but the hepatorenal syndrome is very rare.

EXPERIMENTAL RESEARCH

Ellis and Dragstedt [*8*] (1930), in a series of experimental ligations of the hepatic artery in dogs, proved that toxemia is associated with bacterial growth, rather than with the necrosis of liver cells, as was pointed out by Wilensky. This opinion was supported by Rappaport et al. (1949) and by my experiments with the use of antibiotics.

Naegeli et al. [*15*] (1933) and Schilling et al. [*20*] (1950), using special cross-circulation techniques, proved that hypoxia is a powerful factor leading to necrosis of the liver.

Portal circulation was thought to be responsible for liver necrosis. Löeffler [*14*] supposed that portal thrombosis plays a dominant role. This theory was supported by Deysach [*6*], Wakim and Mann [*26*], who found the prelobular arteriocaval anastomoses, which open in changed physiological conditions forming a shunt of the liver and causing hypoxia of the liver cells. But the renal function in these conditions was not investigated until Ramstrom's [*19*] report was published. In his series of pure experiments of hepatic arterial ligation, he was able to demonstrate the liver necrosis, but no marked functional changes of the renal function were present, and caval ligation did not lead to renal failure.

When a tourniquet-shock was added, the renal failure appeared statistically significant when compared with the control group of animals. The interpretation of Ramstrom's work [*19*] is difficult, as it always is with complex experiments.

In my own series, I used thirty-five adult

mongrel dogs. Hepatic artery ligation was performed under antibiotic protection, and there was no "renal death" in this series. Daily blood samples were examined for the level of non-protein nitrogen, and an elevation of 25 to 50 per cent in the first three days was a constant finding in all surgical experiments. The next days were characterized by the return of non-protein nitrogen to normal.

The daily urine output, except for two to three days of oliguria, returned to normal. Not a single case of anuria was present in this series. All dogs in this series had a testified liver necrosis, and no typical changes of the kidneys could be detected. Therefore, we were not able to find any experimental evidence of the hepatorenal syndrome.

THE HEPATORENAL SYNDROME AND SHOCK

Van Slyke reported periodicity of the renal function in shock conditions, and differentiated three periods as follows:

The Ischemic-Hypoxic Period. The typical feature of this period is the fall of the renal blood flow, greater than it should be, if compared with the total systemic blood flow. This is due to: The nervous regulation (Draper and Whitehead [7]); the mechanical factors and the opening of the rete mirabilis anastomoses (Taylor and Page [23]); and the self-controlled mechanisms of the vasodepressing and vasoexciting material (Shorr, Baez and Mazur [21]) being excreted by the kidneys, according to their state of oxygenation. This phase is what we call the protective, blood-volume saving phase of renal function in shock.

The Phase of Acute Renal Failure. This may be reversible or irreversible leading to the third period.

The Phase of Irreversible Anatomical Changes in the Kidneys. Wakim's [26] research proved that anuria may occur in the first phase. Death almost always occurs before the anatomical changes may be detected.

In my series of experiments I used the conventional prolonged bleeding on thirty-five adult mongrel dogs. Twenty dogs of this series were led to the reversible phase of shock. Seventeen of them withstood the experiment, and were sacrificed on the seventh to the fourteenth day after operation. Fifteen dogs were bled, and the state of profound shock was maintained for seven to twelve hours. All dogs in this group died in the first twenty-four hours.

In the first group no anatomical changes in the kidneys could be detected at autopsy. In the second group some ischemic, and occasionally slight degenerative changes were present. Anuria or oliguria was present for the first two to three days.

Chemical tests were of no importance because of the short period of survival in the second group, and the addition of natrium citrate and amino acids used for replacement of the blood.

In clinical studies, and experimentally, we are unable to differentiate between the second and third period of renal function, this being of purely theoretical interest.

COMMENTS

These two groups of experiments proved that the kidneys answer in a stereotyped way to many pathological factors. We have neither clinical nor experimental facts to confirm the existence of the hepatorenal syndrome as a separate entity.

As proved by Ramstrom, the liver plays a protective role to the kidneys under shock or stress conditions.

The overexcretion or lowered deactivation of the antidiuretic hormone causing oliguria, hypochloremia, water and retention of catabolites may play a certain role. This was described as the syndrome of renal disfunction after valvulotomy (Wilson et al. [29], Goodyear et al. [9], Leaf et al.), and it may apply to other conditions.

CONCLUSIONS

We cannot discuss the hepatorenal syndrome as a clinical entity. The syndrome is probably the reaction of the kidneys to non-specific factors. The kidneys react in a very uniform manner to many shock agents. If we discuss the hepatorenal syndrome as a systemic reaction to shock, its clinical interpretation becomes clearer.

SUMMARY

Historical data about the hepatorenal syndrome is discussed. Clinical and experimental studies are reported. Some mechanisms of acute functional renal failure are discussed. The hepatorenal syndrome as an answer to shock and stress is pointed out.

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Results of Operations for Lumbar Disc Protrusions

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THIS report is an analysis of the results in 229 of 421 patients with lumbar intervertebral discs operated on at the Hines Veterans Administration Hospital from 1949 to 1955. Patients with a definitely protruded or extruded disc are included. All cases which were described by the surgeon as "boggy" disc, slight bulging, narrowed interspace, hypertrophic ligamentum flavum, varicosities, scarring, or edema of the nerve root were eliminated. While many cases so described were probably protrusions, they were excluded from the series. The operations were all performed by the neurosurgical service with the exception of spinal fusions. These cases were performed as combined neurosurgical and orthopedic procedures.

As early as 1864, Lasegue [2] described the protection that flexion of the lower extremity gave in sciatica, and in 1911 Goldthwait [1] suggested that protrusion in the lumbar region could account for low back pain and sciatica. It remained for Mixter and Barr [4] (1934) to report a sereis of patients operated upon for lumbar disc protrusions. Since then hundreds or even thousands of cases have been reported in the literature, both by orthopedic and neurological surgeons. It is not within the sphere of this paper to discuss the merits of fusion or nonfusion, or the conservative versus radical treatment of disc protrusion. Millikan [3] (1954) compared conservative and surgical treatment in 429 cases and found that surgical treatment was more satisfactory as far as ability to return to work and recurrence of attacks were concerned.

The analysis of the results in our patients has been based on the following questionnaire:

VETERANS ADMINISTRATION HOSPITAL
HINES, ILLINOIS

(1) Do you feel the operation was
  (a) a complete cure_____
  (b) satisfactory_____
  (c) a failure_____
(2) Are you doing the same work as before the operation? Yes or No.
  (a) lighter work in the same field_____
  (b) another field of occupation_____
(3) Leg pain
  (a) completely gone_____
  (b) occasional pain or discomfort_____
  (c) no improvement_____
(4) Low back pain
  (a) completely gone_____
  (b) occasional pain or discomfort_____
  (c) no improvement_____
(5) Do you have any difficulty in walking
  (a) long distances_____
  (b) short distances_____
(6) Do you have any difficulty in driving?
  Explain_____
(7) (a) What is your present work, i.e., farmer, housewife, office worker, machinist, etc.?_____
  (b) In your work, are you lifting, driving, sitting, working long hours or doing other physical work?_____
  (c) Do you have to take off any time from your work because of your previous complaints?_____
(8) Have you had to have any more operations for the same complaints? Yes or No._____
  If yes, was the second (or third) operation successful?_____
  Was a spinal fusion done?_____
  Explain_____
(9) Remarks_____
  Name_____
  Address_____

TABLE I
RESULTS REPORTED BY PATIENTS

Results	No. of Patients	Per cent
Cures	35	11
Satisfactory	174	81
Failures	20	8
Total	229	100

The questions, which were sent to 421 patients, were phrased so as to obtain specific answers that could be readily tabulated. There were 229 questionnaires returned, 118 were returned as undeliverable and seventy-eight patients presumably received a questionnaire but failed to respond. The responses on the 229 questionnaires returned have been tabulated.

Table I give the patient's impression of his operative results. While it can be assumed that the terms "cure," "satisfactory" and failure" could have many different meanings to the individual answering the questionnaire, the tabulation of the replies gives totals which correspond to the results reported by many writers.

In Table II the residual symptoms of ten patients who considered themselves cured are listed. The fact that ten patients in this group did list residual symptoms indicates the difference in the meaning of "cure" to various patients. Table III gives the past and present occupations in the "cured" group. Again it will be noted that fifteen patients in this group have either changed occupations or are doing lighter work in the same field. The representation of laborers and white collar workers was almost equal in this group.

TABLE II
REPORT OF RESIDUAL SYMPTOMS BY PATIENTS REPORTING "CURE"

No symptoms	25
Low back and leg pain	5
Low back pain only	4
Leg pain only	1
Total	35

Tables IV and V list the symptoms and the past and present occupations of 174 patients who reported their result as satisfactory. Six of these patients reported no symptoms but only one was doing the same work as before operation and four were not working. Three patients with only pain in the leg reported no improvement but two of these were doing the same work as before operation and all three reported their result as satisfactory. Of the 174 patients in this group, only fifty-two (30 per cent) are doing the same work as before operation. However, in this group laborers outnumbered white collar workers in the proportion of two to one.

Table VI gives the occupation of the twenty patients who reported failure of the operation. All of this group have continued to have low back and leg pain. Six reported this pain to occur occasionally and fourteen reported no improvement. Of the thirteen patients who are working, one is a laborer and twelve are in sedentary occupations.

Of the 229 patients, forty-three (19 per cent) underwent additional surgery. Spinal fusions were carried out in twenty-four (10 per cent) of these patients. Table VII lists the additional surgery performed in each group of patients. It will be noted that over one-half (65 per cent) of

TABLE III
OCCUPATIONS OF PATIENTS REPORTING "CURE"

Symptoms	Same Occupation	Lighter Work in Same Field	Different Occupation
None	14	3	8
Low back and leg pain	1	1	3
Low back pain only	4		
Leg pain only	1		
Total	20	4	11

TABLE IV
REPORT OF SYMPTOMS BY 174 PATIENTS REPORTING A SATISFACTORY RESULT

Symptoms	No. of Patients
None	6
Low back and leg pain	137
Low back pain only	14
Leg pain only	17
Total	174

TABLE V
COMPARISON OF OCCUPATIONS AND SYMPTOMS AMONG 174 PATIENTS REPORTING A SATISFACTORY RESULT

Symptoms	Same Occupation	Lighter Work in Same Field	Different Occupation	Not Working
None	1		1	4
Low back and leg pain	33	53	49	2
Low back pain only	8	4	2	
Leg pain only	10	1	6	
Total	52	58	58	6

TABLE VI
OCCUPATIONS OE TWENTY PATIENTS REPORTING FAILURE

Occupation	No. of Patients
Same occupation	2
Lighter work	7
Different occupation	4
Not working	7
Total	20

the group reporting failure had multiple operations. In each of the other two groups 14 per cent of the patients had one or more secondary operations. The unquenchable optimism of some patients is shown by the two patients who reported a satisfactory result after four operations.

We believe that in most cases of back pain with sciatica or intervertebral disc syndrome, further operations in the lumbar area should not be advised after two explorations unless a competent orthopedic consultant feels that fusion will be of benefit. This assumes that the patient does not already have a satisfactory fusion. It is our opinion that cordotomy is preferable for relief of pain in such cases.

It is a practice in The Veterans Administration Hospital to perform myelography on all patients prior to surgery for disc operations. Myelograms were performed upon 218 of the 229 patients. There were nineteen normal myelograms. This low figure, an error of 8.7 per cent compared to the usually reported 15 per cent to 20 per cent of error, can be explained by the fact that our cases were all grossly protruding or extruding discs. Thus, this series does not include patients with apparently positive myelograms in whom no disc protrusions were found at operation. These cases comprise part of the usually quoted percentage of error.

COMMENTS

Spurling and Grantham [6] (1949) reported their results in 327 of 377 patients upon whom they had operated. These patients had also reported by questionnaire. They reported 40 per cent completely cured. Fifty-two per cent could be considered as satisfactory making a total of 92.9 per cent satisfactory results. Eighty-five per cent were doing the same type of work, 12 per cent were gainfully employed and 2 per cent were unemployed.

In 1952 Woolsey and Tsang [9] reported the results in 143 patients who replied to a questionnaire. In a group of eighty-five private patients, 23.5 per cent were cured, 70.6 per cent improved and 5.9 per cent were unimproved. In a group

TABLE VII
RESULTS OF ADDITIONAL SURGERY PERFORMED (FORTY-THREE PATIENTS)

Results	Per cent	Spinal Fusion				Disc Protrusion			Removal of Scar
		1st Operation	2nd Operation	3rd Operation	4th Operation	2nd Operation	3rd Operation	4th Operation	
Cures	11,6	3	1						1
Satisfactory	58.3	6	3	1		11	2	2	
Failures	30.1		9		1	3			
Total	100.0	9	13	1	1	14	2	2	1

of fifty-eight veterans, 6.9 per cent were worse. In this group 91.7 per cent of the private patients and 89.6 per cent of the veterans were working.

In 1954 Millikan [3] compared 329 patients treated surgically with 100 treated conservatively. Fifty per cent of the surgically treated were working in their former occupation full time and 74 per cent were working at 75 per cent capacity.

O'Dell et al. [5] (1954) reported on the end results in 450 patients who were followed from one to ten years and were surveyed by questionnaire. They reported good results in 82 per cent of the cases, fair results in 6.9 per cent and failures in 11.1 per cent.

In 1954 one of us [7] reported the results of disc operations in industrial workers, comparing thirty-five of these with 192 patients without liability. In the patients with liability, 37 per cent good, 51 per cent fair and 12 per cent poor results were obtained as opposed to 83 per cent good, 12 per cent fair and 5 per cent poor results in the patients without liability.

In our present study there were 229 replies from patients who had been operated upon for a protruded or extruded lumbar intervertebral disc. Satisfactory results were reported in 92 per cent and failures in 8 per cent. Complete cure was obtained in only 11 per cent. However, if one takes into consideration the fact that these patients are all verterans in whom disability is a real concern, hesitancy to report complete relief of symptoms can be expected. Thirty-one per cent were employed in the same occupation as before operation, 32 per cent were doing lighter work in the same field and 32 per cent were in other occupations making a total of 95 per cent. Five per cent were not working. It is interesting to note that in twenty failures, although seven patients were not working, two were in the same occupation and seven were in lighter work in the same field. Thirteen (65 per cent) were occupied gainfully.

The ages of our patients ranged from twenty to fifty-eight years. There were only four women in the series. Any reported series is subject to criticism. The type of questionnaire, responses of the patients, and the interpretations of the surgeons all modify the report of results. The fact remains that the patient is the one being treated and his or her interpretation of the result is the most important factor in the final analysis. In our study it would be possible to change failures to satisfactory results and satisfactory results to cured if we consider the postoperative occupations of the patients. However, the converse could also be done. Whether or not the patient is doing the same work as before operation does not always depend on the surgical result. Patients may change their occupation for reasons not connected with their physical condition. On the other hand, some patients with persistent but not disabling pain may prefer to continue at heavy work for financial reasons.

It has been pointed out [7] that some liability patients, after obtaining a settlement on the basis of partial permanent disability, have later been found to be working at the same or heavier work than before operation. These patients obviously have had a better result than the terms of their settlement with the insurance company would indicate. This type of outcome can not be expected in the case of a veteran who continues to draw a disability allowance as long as he remains disabled.

The criteria for surgical intervention should be exact and a thorough course of conservative treatment should be required before operation in patients with definite neurologic findings. Patients with pain in the back without radiation into the extremities and without neurologic findings should rarely be considered for surgery. Myelography was done in 91 per cent of our patients. We feel this is valuable in localizing the lesion and ruling out possible neoplasm. However, negative myelograms should not be considered a contraindication to surgery if the clinical signs and symptoms indicate the presence of a disc protrusion.

One of us [7] has recently reported a further survey of his personal patients and compared their results with a previous report. He has concluded that whether or not fusion is carried out and the type of operation that is performed do not materially affect the results. The selection of patients for operation does affect the results and we would like to emphasize that the best operative results will be obtained in patients who have clear-cut, well defined syndromes of low back and sciatic pain and who are psychologically stable and well motivated toward recovery.

CONCLUSIONS

The surgical results in actual protrusion of the lumbar intervertebral disc are encouraging

in this series. However, the occurrence of 8 per cent failures in an accepted surgical procedure in patients with proven pathology points out the need for more critical analysis of patients selected for surgery.

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A New Surgical Absorbable Hemostatic Agent

EXPERIMENTAL AND CLINICAL EVALUATION

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OXIDIZED regenerated cellulose* is a new, specifically hemostatic material which is readily absorbed without adverse reaction when left in various body tissues for the purpose of controlling hemorrhage.

It is supplied in the form of gauze-like strips of various sizes and lengths or carded fiber pads similar in appearance to pure absorbent cotton. This latter form is designed primarily for neurosurgery, intraoral and intranasal procedures; its use in these fields falls beyond the scope of this paper. Both types are prepared from a very pure form of regenerated cellulose composed of fibers of uniform diameter and chemical composition made by the viscose process, and subsequently oxidized to a carefully controlled carboxyl content as described by Ashton and Moser [1]. By this method a solution formed from the treatment of cotton linters, or other suitable source of alpha-cellulose, with an alkalinized organic solvent is forced through spinerettes of suitable diameters into a coagulating bath where the cellulose is regenerated as a continuous fiber which can then be knitted or carded into the type of final product desired.

The regenerated cellulose resulting from this process is, of course, far purer than the original cellulose with which the process was started. The material is of uniform molecular weight and the fibers which it forms are of uniform diameter throughout their length. In this respect they differ from cotton fibers, which are tapered and thicker at one end than the other. This consideration is important since it is because of the physical and chemical uniformity of the regenerated material that the all important step of oxidation can be carried out in a uniform and reproducible manner, which is not the case when natural cotton is used, as it is in the older type products, as the starting material for the oxidation process.

The oxidation process is carried out after the product has been fabricated in final form, the primary alcohol radicals of the cellulose molecule being oxidized to carboxyl (−COOH) groups and carefully purged of undesirable by-products by subsequent neutralization and washing. By this process the desired degree of oxidation of 20 per cent can be achieved with a uniformity which varies within limits of only ±1.0 per cent. This close control is made possible by the fact that regenerated cellulose has a uniform and reproducible molecular size distribution, while natural cotton is quite variable. For these reasons it has been possible to obviate the extreme variation in absorbability, tissue reactivity and hemostatic effectiveness characteristic of the older product [2–10]. Not only is the new product extremely uniform, it is exceedingly pure, the total of all extraneous substances present being less than 15 parts per million.

The special characteristics which make this product useful as an absorbable hemostatic agent arise from the fact that the regenerated cellulose is oxidized to the true chemical compound, polyanhydroglucuronic acid, which, in addition to having hemostatic properties, is

*The material used in this study was Surgicel® Absorbable Hemostat, supplied by Johnson & Johnson, New Brunswick, New Jersey.

soluble in weak alkalies and can be hydrolyzed by living tissues. Such chemical degradation, accomplished by enzymes of the carbohydrase system, contributes to the ease with which the material is absorbed in body tissues and the minimal degree of tissue response occasioned by its implantation.

When exposed to blood, either *in vitro* or under surgical conditions, the material, which has a pH of 3.5 to 4.5, turns very dark brown or black due to the formation of acid hematin. The acid nature of the material itself probably produces some hemostatic effect due to styptic action. In addition, hemostasis very probably depends in part upon the marked affinity of polyanhydroglucuronic acid for hemoglobin and other blood proteins. A large hydrated aggregate is thus formed which controls bleeding by simply acting as a cork in the mouths of the vessels, and secondarily supplying a scaffolding for clot formation.

The hemostatic activity of Surgicel probably does not depend upon the physiologic clotting mechanism *per se*, but on the formation of what might be termed an "artificial clot" as described. This probably explains its effectiveness, which has been observed by others in controlling surgical bleeding in many cases of hemophilia, thrombocytopenic purpura and similar blood dyscrasias, although in one instance (*vide infra*) it was noted that clotting of heparinized blood did not occur *in vivo*. Hemostatic action is not enhanced by the addition of other agents such as thrombin (which in any case would be destroyed by the low pH of the gauze).

EXPERIMENTAL DATA

Oxidized regenerated cellulose has been studied extensively in rats and dogs. The experiments in rats were conducted with four objectives in mind: (1) to obtain a measure of the expected rate of absorption in subcutaneous tissues; (2) to study the tissue responses to the material; (3) to check the uniformity of sequential production lots and (4) to study the effect of accelerated aging on absorption. The experiments in dogs were performed to simulate actual clinical usage and to observe the hemostatic properties of the material.

Material and Methods

Rats. Utilizing the Frantz-Lattes technic [11,] pledgets of the knitted gauze type weighing 75 mg. were implanted in the subcutaneous tissues of rats (CD strain). The method enabled the sample to be deposited in the caudal region away from the cervical incision. In this way any influence that might have been contributed by the surgical procedure was minimized. One hundred sixty samples of the fabric were implanted and an autopsy was performed upon each animal. In the majority of cases the animals were sacrificed on the seventh and fourteenth or fifteenth day. In order to observe very early tissue responses, a limited number of rats were sacrificed at one, three, five and seven days. By the same method, the effect of aging upon the material was studied on samples stored at 70°, 100° and 120°F. Tissues recovered from the implant sites were fixed in Bouin's fixative and stained with hematoxylin and eosin, Van Gieson's stain and Texchrome.®*

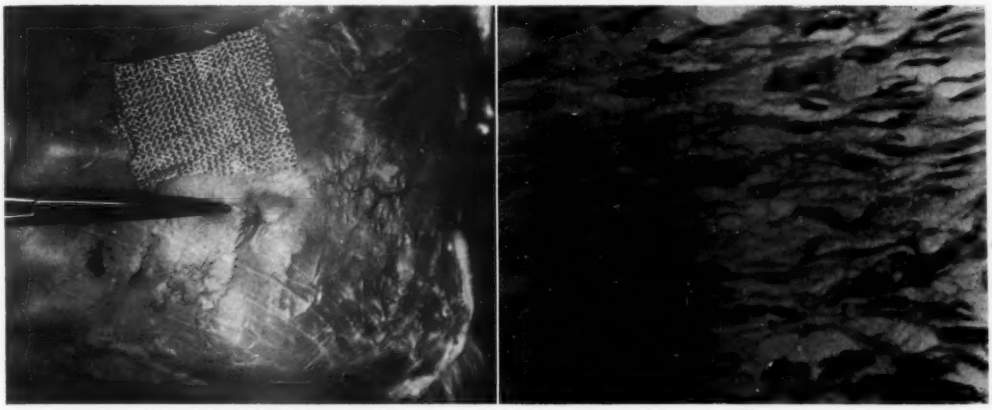
Dogs. Five mongrel dogs were used in checking the safety of the material under simulated clinical use. In all instances, the gauze type was employed and this was moistened in saline prior to use. The animals were sacrificed at times varying from thirty to sixty-two days.

Results

Rats. Necropsy data obtained at seven and fifteen days are presented in Table 1. At seven days the mass bore no resemblance to the original fabric but consisted of an off-pink to white, soft, gelatinous material (Fig. 1A). A brown pigment was frequently observed at the site of implantation and was considered to be hematin. A slight to moderate degree of hyperemia was associated with the residue. In some cases the implant appeared to be completely absorbed. Microscopically, the reaction was characterized by active fibroplasia with moderate numbers of macrophages (Fig. 1B). When stained with hematoxylin-eosin the residue appears as an amorphous eosinophilic mass invaded by proliferative fibroblasts and large macrophages frequently containing pigment. There has been no suggestion of capsule formation. In most instances there is some degree of polymorphonuclear and mononuclear infiltration, with capillary proliferation.

At fifteen days it is usually impossible to identify the implant grossly. However, as far

* A commercial dye used for the identification of fabrics, and obtained from Fisher Scientific Company, Fairlawn, New Jersey.



1A 1B

FIG. 1. A, appearance of implant compared to original size seven days after use in subcutaneous tissues of the rat. B, microscopic appearance of implant site at seven days. Note absence of tissue reaction. Original magnification × 800.

TABLE 1

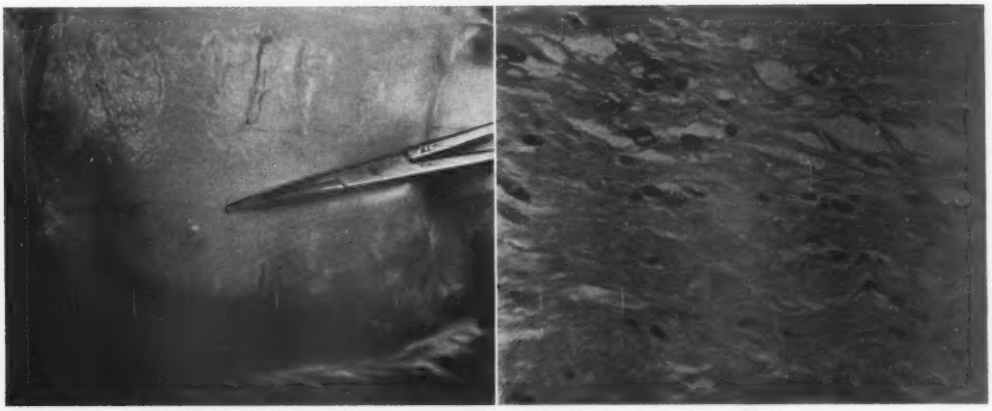
GRADES OF REACTION AS NOTED GROSSLY AT AUTOPSY

Surgicel Absorbable Hemostat (Sample No.)	No. of Rats Employed		Autopsy Mass†		Hyperemia		Over-all Tissue Reaction†		Ratio of Animals with Complete Absorption‡	
	7 Days	14 to 15 Days	7 Days	14 to 15 Days	7 Days	14 to 15 Days	7 Days	14 to 15 Days	7 Days	14 to 15 Days
Type 102*										
Lot 4	10	8	1.1	0.0	1.2	0.4	.18	0.5	0/10	8/8
5	10	9	1.0	0.0	1.9	0.2	2.4	0.4	3/10	9/9
6	10	5	0.9	0.4	0.9	0.4	1.3	1.0	3/10	3/5
7	10	9	1.2	0.6	2.3	1.2	3.4	2.1	1/10	6/9
10	8	9	0.6	0.1	1.8	1.0	2.3	1.6	5/10	8/9
Type 106*										
Lot 3		5		0.8		3.0		2.2		2/5
4		6		0.7		1.2		1.5		3/6
5	10	10	0.6	0.5	1.4	0.8	1.6	1.6	5/10	7/10
7	10	10	0.4	0.4	0.7	0.3	1.3	1.1	7/10	7/10
Mean	10	8	0.8	0.4	1.4	0.9	2.0	1.4	3/10	6/8

* Type 102, knitted fabric; type 106, carded web.
† 0 = absent, 2 = slight or small, 4 = moderate, 6 = marked, 8 = severe.
‡ Animals with complete absorption compared to total number of animals.

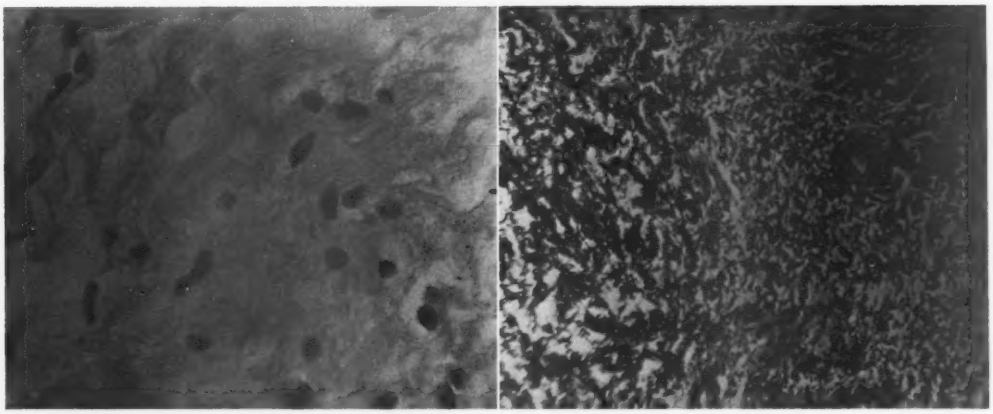
as subjective grading was concerned, the barest suggestion of mass was recorded as seen in Table 1 (Fig. 2A). In such instances, it was not possible to identify the material microscopically. Consequently, the indication of a mass here more correctly refers to visible evidence of a remaining tissue response. Microscopically, the reaction differed from that at seven days in degree and relative predominance of the different types of cells. There were few phagocytic elements, and usually no polymorphonuclear cells, with a predominance of fibroblasts (Fig. 2B).

The following observations were recorded in rats autopsied at one, three and five days. At one day, the channel in the subcutaneous tissue



2A 2B

FIG. 2. A, appearance of oxidized regenerated cellulose implant at fifteen days in subcutaneous tissues of the rat. B, microscopic appearance of implant site at fifteen days. Note complete organization. Original magnification × 400.



3A 3B

FIG. 3. A, appearance of oxidized regenerated cellulose after twenty-four hours in subcutaneous tissues of the rat. Fabric reduced to amorphous material. Original magnification × 50. B, at three days the implant site is invaded by large macrophages. Note absence of polymorphonuclear leukocytes. Original magnification × 800.

into which the pledget had been introduced contained a considerable amount of translucent, viscous fluid intermingled with bits of gelatinous material. Nothing resembling the original fabric was observed. Tissue sections stained with Texchrome revealed fragments of amorphous lavender-colored material associated with edema but showing little evidence of a cellular response (Fig. 3A). At three days the subcutaneous channel was no longer apparent but the implant could still be recognized as a soft gelatinous mass. Microscopically, the cellular response was moderate and consisted mainly of large macrophages (Fig. 3B). The area was still edematous, accounting for its gross appearance. At five days there was a significant reduction in the size of the mass and overall response. Microscopically, the degree of edema was lessened and evidence of fibroplasia was apparent.

Dogs. Operative Procedure: Animal No. 1605 was operated upon on March 20 and sacrificed on May 21 (62 days later). An incision was made in the diaphragm through a right thoracotomy to expose the right lobe of the liver. A large hepatic biopsy wound measuring

approximately 1 inch by 0.25 inch by 0.5 inch deep was created. The hemorrhage that resulted was arrested by lightly packing the wound with approximately 280 mg. of the knitted gauze type. The sample was simply held in place by virtue of its position in relation to the diaphragm, and the incision was closed with No. 3-0 chromic gut. Prior to closing the chest, another sheet of knitted gauze type measuring 3.5 inches by 1.25 inches was placed against the parietal pleura and was maintained in that position by means of six interrupted silk sutures.

Results: At the time of sacrifice there was no evidence of the implant at either site and the tissues were completely free of adhesions. Because of this, no tissues were taken for microscopic study.

Operative Procedure: Animal No. 1615 was operated upon on April 21 and autopsied on June 9 (49 days later). Through a midline abdominal incision, the left kidney was exposed and an elliptical wound measuring 0.5 inches by 0.35 inch by 0.25 inch deep was created in the cortex and medulla after reflecting the capsule. The wound was packed with a piece of the knitted gauze type measuring approximately 2 inches by 1.5 inches (115 mg.). The implant was maintained in place by suturing the capsule with No. 5-0 silk. A segment of small intestine was then wrapped with a piece of fabric measuring 6 inches by 1 inch. The fabric was held in place with a few interrupted sutures of No. 5-0 silk. The object of this procedure was to determine whether a fibrotic reaction in response to the material would result in stricture.

Results: There was no significant change in the body temperature. The urological findings indicated no apparent interference with function. The daily output of urine remained normal; the pH and specific gravity did not change although traces of bilirubin and protein were observed. The pyelogram revealed excretion to be at the same rate from both kidneys. There was no indication of intestinal obstruction. At autopsy a small depressed scar was visible at the renal implantation site. On section this appeared as a depression filled with fibrous tissue, largely in response to the unabsorbed silk sutures. There were no adhesions to the abdominal wall. The intestinal implantation site was completely normal with no trace of the fabric. The site was identified only by the presence of stay sutures. There was no stricture nor were there visible adhesions. On section it was not possible to determine where the material had been placed. The serosal surface of the ileum appeared completely normal.

Operative Procedure: Animal No. 1642 was operated upon on April 12 and sacrificed on June 9 (49 days later). Craniotomy was performed by removing a portion of the dorsal skull measuring 3.0 cm. by 1.5 cm. The dura was then excised and a portion of the knitted gauze type approximately 0.75 $cm.^2$ was placed on the surface of the right lateral gyrus of the cerebrum. The dura was sutured with 5-0 silk. Due to the extensive hemorrhagic oozing which usually accompanies this type of procedure, pieces of the fabric were packed in the vascular channels of the frontal and sagittal crests. Portions were also packed below the cranium but above the dura. These implants resulted in slight compression of the cerebrum. The wound was closed by returning the excised portion of the cranium and wiring with tantalum.

Results: No significant rise in body temperature was recorded. The animal was slightly ataxic on the day immediately following surgery. At autopsy, no evidence of a lesion was present at the site of implantation. The craniotomy wound was almost healed but the dura showed some increased thickening. There was no evidence of the fabric grossly or microscopically nor was there any indication of scar formation.

Operative Procedure: Animal No. 1655 was operated upon on April 28 and sacrificed on June 18 (50 days later). Through a right thoracotomy the liver was exposed by incising the diaphragm. As was the case with dog No. 1605, a large mass (approximately 280 mg.) was implanted in the organ and retained there by virtue of its position in relation to the diaphragm. The pericardial sac was then opened and a piece of the fabric measuring 2 inches by 1.5 inches was placed adjacent to the heart. The pericardial incision was closed with No. 5-0 silk. An interesting observation was the fact that the material effervesced when it came in contact with the pericardial fluid.

Results: At autopsy, it was possible to identify the hepatic biopsy site as a slight depression but it was not possible to identify any of the original packing material. There was a linear adhesion between the pericardium and

epicardium. Upon inspection it was noted that this occurred in response to the suture. This observation was confirmed by microscopic study. The remainder of the epicardium was smooth and glistening and there was no evidence of foreign material in the pericardial sac.

TABLE II
CLINICAL FINDINGS IN FIRST 100 CONSECUTIVE CASES IN WHICH SURGICEL WAS USED

Occasion for Use	No. of Cases
Abdominal (48 cases):	
Liver biopsy	17
Pancreatic biopsy and resection	3
Gall bladder bed after cholecystectomy	7
Gastric resection	2
Colon resection	2
Omental and mesenteric lymph node biopsy	3
Retroperitoneal tumor biopsy and resection	3
Renal biopsy and resection	3
Lumbar sympathectomy	2
Dacron graft replacing abdominal aortic aneurysm	4
Evacuation of hematoma of abdominal wall	2
Thoracic (30 cases):	
Biopsy of mediastinal tumor	4
Retropleural resection of posterior mediastinal neuroblastoma	1
Pulmonary biopsy and resection	4
Mitral commissurotomy, bleeding from left auricle and/or pulmonary artery	3
Bleeding from each cardiac chamber, aorta, and/or pulmonary artery following open correction of atrial and ventricular septal defect, roof patch for tetralogy, insertion of myocardial wire for heart block, needle site for pressure readings	6
Bleeding from aortic suture line following repair of subaortic stenosis, and coarctation of aorta	3
Transventricular aortic and mitral valvular commissurotomy	7
Dacron graft replacing obstructed innominate artery and aortic coarctation	2
Miscellaneous (22 cases):	
Dacron aorto-iliac-femoral-popliteal by-pass graft	5
Dacron graft replacing femoral and popliteal aneurysm	2
Carotid thromboendarterectomy	2
Biopsy and resection of tumors of neck, larynx, parotid, maxilla, ethmoid, mastoid	6
Donor sites and plastic reconstruction	4
Evacuation of scrotal hematoma	1
Resection of extensive tumor of buttock	1
Hemorrhoidectomy	1
Total	100

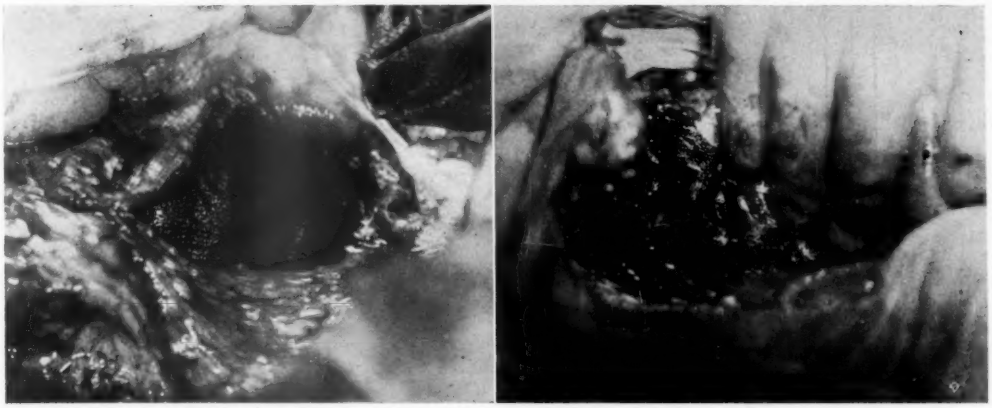
Operative Procedure: Animal No. 1650 was operated upon on May 21 and sacrificed on June 20 (30 days later). Through a midline incision both kidneys were exposed and samples (115 mg.) of the knitted gauze type were implanted in the cortex of each organ. The samples were secured *in situ* by suturing the capsule.

Results: Urologic studies for two weeks following surgery failed to reveal significant functional disturbances. There was possibly a slight delay in excretion of phenolsulphonphthalein. An attempt to obtain a pyelogram with good contrast resulted in the death of this animal, following what proved to be a toxic dose of the radiopaque medium. At autopsy it was possible to identify the material at both of the biopsy sites, which on section were found to consist of hemolyzed blood enmeshed within the unabsorbed cellulose. This was the only instance in which any indication of a foreign body reaction was observed. Occasional giant cells were noted in the periphery of the unabsorbed mass.

CLINICAL USE

The clinical data to be reported are based upon experience with the knitted gauze-like type of fabric. In this form the material is yellow, light in weight, and silky, with a faint odor like caramel custard. The fine-meshed fabric may be applied in a single or double layer as a packing over a flat or curved surface, or as a packing in a cavity or recess. It conforms readily to any contour, no matter how irregular, and may be wrapped easily around tubular structures such as an arterial prosthesis. On contact with blood the Surgicel becomes dark brown and firmer in texture. It usually does not stick to the surgeon's gloves, but clings to the tissues, where it exerts a prompt hemostatic effect. If the operator elects to remove the material when the bleeding has stopped, it does not shred or fall apart, but remains intact.

The first 100 consecutive clinical applications were analyzed for this report. The ages of the patients ranged from two months to seventy-seven years, and the operations were performed by several surgeons. Cautious early use in patients with advanced malignancy was rapidly expanded to free employment to control bleed-



4A 4B

FIG. 4. A, material applied over oozing retropleural space following resection of neuroblastoma. B, material applied around weeping dacron bifurcation graft following resection of abdominal aortic aneurysm.

ing in a wide variety of situations, when it was found to be both effective and well tolerated. In no instance has a wound infection, toxic reaction, or death been attributed to the material. Drainage for longer than the usual period was encountered in only two instances. In both of these (a gallbladder bed, and the site of an extensive neck dissection), a much bulkier volume of packing was inserted than recommended, or necessary. This is an important point to note since in most instances a surprisingly small amount of material is required to control the bleeding; one or possibly two layers of the gauze usually suffice. Contrary to what has been suggested for older type materials, it has not been found necessary to moisten the gauze prior to insertion.

Several of the patients in this series died due to the underlying disease. There were ten autopsies, at intervals of from one to seventy-seven days postoperatively. The material could not be identified grossly in the longer term specimens. However, even at seventy-seven days small flecks of amorphous material could sometimes be detected microscopically in areas of subsiding moderate foreign body reaction. To date the material has not been used in areas known to be infected.

Table II summarizes the clinical situations under discussion.

COMMENTS

As reported previously [*12*], several early cases in which the use of the material could clearly be classified as elective (such as the liver biopsies) are included in this total experience. The great majority of the applications, however, were concerned with the control of troublesome bleeding or oozing from raw surfaces, where no blood vessels could be clamped or controlled with electrocautery, and in some instances its use was considered to be life-saving. It is true that in some instances hemostasis could have been achieved by direct compression with ordinary gauze pads or packing, but without the two-fold advantages of a material that accelerates cessation of bleeding, and can be left *in situ*, to be disposed of in the process of wound healing. For these reasons it is considered to be of special value in the more massive surgical procedures, while at the same time it is obviously a great convenience in many relatively minor surgical situations.

Two areas stand out sharply as prime examples of outstanding usefulness. One is the extensive raw surface left after an extrapleural pulmonary or mediastinal resection. This is illustrated by the resection of a huge posterior mediastinal neuroblastoma in a two year old girl, where the broad oozing surface was controlled by strips of the material left in position against the inner surface of the chest wall, without excessive fluid accumulation in the pleural cavity or unusual reaction despite the early postoperative use of radiotherapy (Co^{60}) (Fig. 4A). Secondly, life-threatening loss of blood due to generalized weeping from the interstices of

fabric grafts, used to replace aneurysms or bypass obstructive vascular lesions, has on several occasions been completely controlled by wrapping the graft with Surgicel and briefly holding it in place (Fig. 4B). The material may be left *in situ* or removed as desired; but removal is not necessary, and the bleeding has occasionally been noted to recur when the material surrounding the graft is unwrapped.

The effectiveness of this material in the presence of blood dyscrasias has not been investigated in this series. A large spontaneous scrotal hematoma in a patient with myeloid metaplasia and constant oozing was completely controlled by this packing, with no postoperative problems. On the other hand, control of severe graft weeping was not achieved in a patient who was heparinized for a temporary pump by-pass during resection of an aneurysm of the thoracic aorta.

SUMMARY

Experimental and clinical observations confirm the preliminary impressions that oxidized regenerated cellulose (Surgicel) is a safe and effective absorbable hemostatic material, which is useful in a very wide variety of surgical situations. Clinical experience with over 300 consecutive cases to date (July 15, 1960) confirms the earlier impressions of applicability and freedom from complications.

Its effectiveness in the control of bleeding from fabric grafts in vascular surgery and from retropleural and retroperitoneal surfaces has been outstanding in this series of 100 consecutive general surgical operations.

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Pancreatic Dornase Aerosol in Postoperative Atelectasis

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PULMONARY complications remain one of the most frequent and serious postoperative problems in major surgery. Thick tenacious tracheobronchial secretions, which are difficult to raise despite hard coughing, cause severe pain in the wound and may result in dehiscence or disruption of the wound. Atelectasis and bronchopneumonia may result, frequently with antibiotic resistant organisms. Commonly used measures such as expectorants, potassium iodide, steam or vapor inhalations, at best are slow acting and frequently ineffectual. It may be necessary to subject the patient to frequent endotracheal suctioning or even bronchoscopy. These two measures are traumatic and frequently do not give the desired result in a postoperative patient. The frequent introduction of a catheter into the trachea is thought by some to be an excellent way of introducing hospital pathogens such as Staphylococcus aureus into the bronchial tree of the patient [17].

Aerosol therapy [2] and detergents such as Alevaire [11] are in common use to clear the tracheobronchial tree, but these too are slow in action and frequently not curative. Enzymes and enzyme activators such as streptokinase-streptodornase (Varidase®) and trypsin, and chymotrypsin have been introduced in recent years. Varidase has been used with moderate success [4,12,13]. Trypsin has been found to be useful by a few investigators [5,6,8,14] and less satisfactory by others [15]. Frequent serious reactions and complications have been reported with its use [8,16,22]. These include dyspnea, chills and fevers, irritation of the mouth and throat, drug rash and nausea and vomiting. Almost all investigators recommend the use of antihistamines [15] or epinephrine with trypsin [7,11,20,21]. Fibrinolysin has been tried but has been effective only when clotted blood plugged the bronchi (unreported data).

Pancreatic desoxyribonuclease (dornase) [10] has been found to be non-toxic as an aerosol, and very effective in liquefying thick secretions and plugs which are adherent to the mucosa and partially or completely obstruct the tracheobronchial tree. It was first used in patients with bronchiectasis, with excellent results [1]. It was next reported to be of possible clinical use in chronic bronchopulmonary disease [18,19]. The use of pancreatic dornase and trypsin together caused some reactions due to the trypsin [5]. We have found this enzyme to be non-toxic, and without irritation in over 300 patients treated. Previous reports on its use in relieving atelectasis and thick secretions in bronchiectasis, chronic pulmonary diseases, in postoperative patients and in lysis of the thick crusts and irritation found in tracheitis sicca, have been confirmed by continued use [3,9]. This has been confirmed by others [19]. At present we believe that dornase is the most useful agent available in the management of postoperative atelectasis, chronic bronchopulmonary diseases with thick tenacious secretions, and tracheitis sicca.

The present report deals with a group of 112 patients with postoperative pulmonary complications including atelectasis who have been treated with pancreatic dornase aerosol.

MATERIALS AND METHODS

Pancreatic desoxyribonuclease (dornase*) is prepared from bovine pancreas and is supplied

* Supplied by Merck Sharp and Dohme, through the courtesy of Dr. R. T. Smith.

TABLE I
PANCREATIC DORNASE AEROSOL IN POSTOPERATIVE PATIENTS

Complication Treated	Total No.	Cures	Improved	No Change
Postoperative atelectasis	43	36	3	4
Postoperative pneumonitis, bronchitis and segmental atelectasis	69	55	10	4
Total	112	91	13	8

in a sterile vial of 100,000 units. Sterile diluent is also supplied in vials of 2 cc. The 100,000 units now are practically always dissolved in 2 ml., but a larger quantity of diluent was used in the earlier cases and is still used occasionally for direct instillation into the tracheostomies. The solution should be used immediately since dornase in solution loses activity rapidly. The solution is delivered via a nebulizer using O_2 or a de Vilbis pump to give a flow rate of 5 to 6 L. per minute. A Bennett respirator or similar equipment may be used. The patient is urged to inhale the material as deeply as possible. The usual rate of use will be 1 ml. in ten to fifteen minutes. In patients with tracheostomies or postlaryngectomy stomas in whom atelectasis or tracheitis sicca develops the dornase is administered by direct spray into the tracheobronchial tree by means of a small polyethylene catheter. One hundred thousand units in 2 to 5 ml. solution are sprayed directly through the tubing.

Antibiotics were continued in most patients treated in this series. No new antibiotics or other new therapy was started at the same time or during the first two days of dornase therapy. In many cases treatments which might be expected to relieve the complication were discontinued when the dornase therapy was started. Endotracheal aspirations were almost universally unnecessary after beginning the dornase inhalations.

RESULTS

One hundred twelve patients were treated in the series to be reported. There was complete relief in 91 and definite improvement in thirteen patients within forty-eight hours. Only eight patients (7 per cent) failed to show improvement. (Table I.)

Of the 112 patients forty-three had major atelectasis, twenty-five of these were patients undergoing thoracic surgical procedures and eighteen were patients subjected to other types of surgery. (Table II.) Thirty-six of the forty-three patients had complete relief of the atelectasis, and three others showed marked improvement in the atelectasis.

Sixty-nine patients suffered from other serious pulmonary complications including bronchopneumonia, obstructive bronchitis, segmental atelectasis and thick tenaceous sputum. (Table III.) In sixty-five of these patients (94 per cent), definite improvement followed the use of pancreatic dornase.

Improvement demonstrated by liquefaction of the sputum and ease of raising the sputum occurred in the majority of cases within one to two hours after the first inhalation. The paroxysm of cough with severe pain of the wound and frequently severe respiratory distress would be relieved almost immediately and endotracheal aspirations were almost never necessary after the start of dornase therapy. Patients who were unable to sleep because of nagging cough were relieved by an inhalation one to two hours before time for sleep.

TABLE II
PANCREATIC DORNASE IN POSTOPERATIVE MAJOR LABOR ATELECTASIS

Type of Surgery	Total No.	Dornase Administration (days)	Response Time (days)	Good Results	No Change
Postoperative pulmonary resection	11	5	1	10	1
Postoperative thoracotomy	14	4	2	12	2
Postoperative abdominal and other surgery	18	6	2	17	1

TABLE III

PANCREATIC DORNASE IN POSTOPERATIVE PNEUMONITIS, BRONCHITIS AND SEGMENTAL ATELECTASIS

Type of Surgery	No. of Cases	Dornase Administration (days)	Response Time (days)	Good Results	No Change
Postoperative pulmonary resection	13	6	2	13	0
Postoperative thoracotomy	26	5	1	24	2
Postoperative abdominal and other surgery	30	5	2	28	2

THORACIC SURGERY

The most serious problems were in the patients who had undergone thoracic surgery particularly those with pulmonary resections.

Eleven patients had a major atelectasis following pneumonectomy or lobectomy. Atelectasis occurred twenty-four hours to five days after operation. All patients had a critical respiratory difficulty, and high fever, rapid respirations and cyanosis, even with oxygen. The usual methods of treatment including steam inhalations, alevaire, potassium iodide, nasotracheal aspirations, antibiotics and others had been used without relief. Two patients also had undergone bronchoscopy without improvement. Of the six patients with atelectasis following lobectomy a rapid clearing of the obstructive process was observed in five patients. The five patients who underwent pneumonectomy all had a rapid response. Improvement began within one hour after the first inhalation, and complete relief of the atelectasis was obvious in twenty-four to forty-eight hours. In none of these patients was there any evidence of bronchopleural fistula during or after the administration of dornase. Treatment was begun in all patients on the second to fifth postoperative day. Case 1 illustrates the successful treatment of atelectasis after pneumonectomy.

CASE I. F. K. (New York Hospital No. 778,001), a forty-eight year old white woman was admitted because of cough of a few weeks' duration. X-ray film of the chest revealed a neoplasm of the left lung. A preoperative bronchoscopy showed a partial block of a right basilar bronchus with mucous, and a polyp was removed with resulting clearing of the bronchus. On September 26, 1957, a left pneumonectomy was performed. The pathologic diagnosis was bronchogenic carcinoma of the left lung. On the first postoperative day (September 27), a shift of the mediastinum to the right was noted, and by the second postoperative day (September 28) this was alarming. (Fig. 1.) It was difficult at first to tell whether this was due to tension in the left side of the chest or to partial atelectasis on the right side. However, definite signs of decreased breath sounds and rales at the right base and over the right lower anterior lung field corresponding to the right middle lobe were noted, and roentgenograms showed evidence of atelectatic changes in the right lung. There was no apparent clearing with endotracheal aspiration and alevaire. Pressure in the left pleural cavity was negative. She was started on pancreatic dornase 100,000 units in 2 ml. diluent by inhalation on September 29. She received two treatments on September 29 and one on October 1. By this time she had only a few rales at the right base and was breathing easier. Respirations had come down from 24 to 26 per minute to 18 to 20 per minute. On the following day (October 2) she had no evidence of rales or other abnormalities on physical examination and the x-ray film showed clearing. (Fig. 2.) Her postoperative course after this was uneventful.

Fourteen patients were treated for major atelectasis after thoracic procedures without extensive pulmonary resections. These cases included esophagectomy, resection of mediastinal tumors and implantation of lung carcinoma with radioactive isotopes. Twelve of these resulted in rapid, complete relief of the obstructive atelectasis.

CASE II. J. R. (M.H. 23-39-56), a sixty year old white man was admitted in September 1959 because of fever and cough, and malaise of four months' duration. Examination revealed dullness and expiratory wheezes in the right posterior part of the chest. Roentgenograms of the chest revealed a neoplasm of the right hilum. At bronchoscopy a granular lesion of the orifice of the right upper lobe of the lung was biopsied and the pathologic report was carcinoma. The patient had poor pulmonary

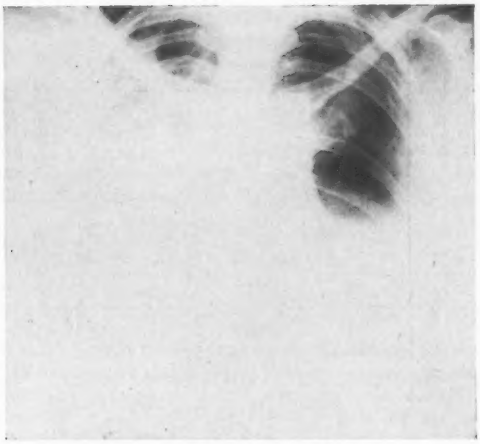

FIG. 1. Case 1. Note evidence of atelectasis of remaining right lung, after pneumonectomy.

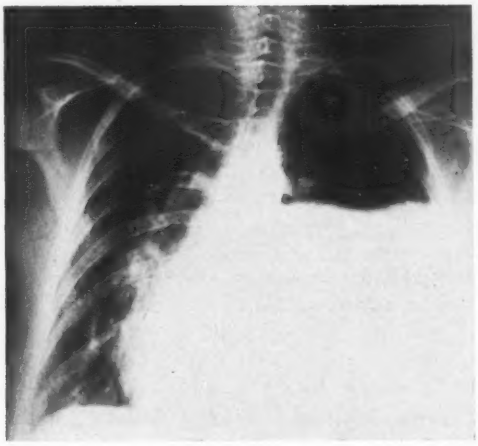

FIG. 2. Case 1. Note complete re-expansion of the right lung after three days of treatment with pancreatic dornase.

FIG. 3. Case II. Two days postoperatively, atelectasis of right upper lobe with opaque seeds in right hilar area.

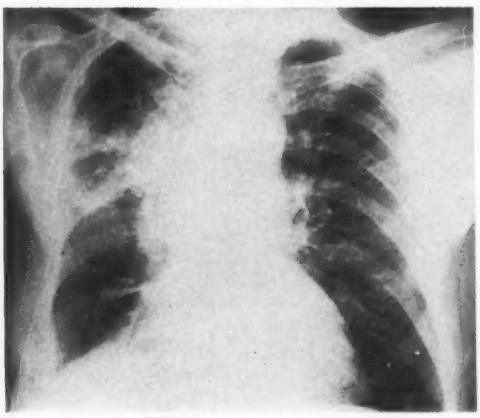

FIG. 4. Case II. After five days of dornase inhalations. Improvement began on day after treatment started.

function by all tests. On September 15, 1959, a right thoracotomy was performed. A large mass was found in the right hilum with fixation to the mediastinum. It was considered non-resectable because of involvement of the great vessels. Twenty-nine radon seeds were implanted into the hilar mass. Twenty-four hours after operation the temperature rose to 103°F., and the patient had great difficulty in raising sputum. Despite frequent nasotracheal aspirations, steam inhalations and potassium iodide, atelectasis of the upper lobe of the right lung developed. A roentgenogram of the chest on September 17, 1959 (Fig. 3) revealed complete atelectasis of the upper lobe of the right lung. He was dyspneic and slightly cyanotic. His symptoms and physical signs progressed and dornase inhalations were begun on September 18, 1959, giving 100,000 units in 2 ml. of aerosol three times a day. Within twenty-four hours respirations became normal, and he began to raise sputum in greater quantity and more freely. The temperature came down to normal within forty-eight hours, and examination revealed better aeration of the upper lobe of the lung. A roentgenogram of the chest on September 19, 1959, showed beginning resolution of the atelectasis. Dornase was stopped on September 23, 1959, and the roentgenogram of the chest (Fig. 4) showed complete clearing of the atelectasis.

Of sixty-nine patients with postoperative pneumonitis, bronchitis and segmental atelectasis, thirty-nine had undergone thoracic operations. (Table III.) In thirteen patients segmental atelectasis developed following pulmonary resections. All of these improved rapidly with the administration of 100,000 units of dornase twice a day. The sputum was raised with much greater ease, became much thinner and fever disappeared. This was also true in twenty-four of twenty-six patients who had thoracotomies for exploration, esophagectomy, resection of mediastinal tumors or implantation of radioactive materials for carcinoma. Here the dornase aerosol was effective in one day. The two patients who did not respond were patients who underwent exploratory thoracotomy for carcinoma of the lung which turned out to be non-resectable. One patient had tumor encroaching upon the bronchus and another patient had severe radiation fibrosis of the lung, an obvious explanation for the lack of effect.

OTHER TYPES OF SURGERY

Although pulmonary complications following abdominal or pelvic surgery may not be as dramatic as after pulmonary resections, they can cause serious difficulties. Eighteen patients with atelectasis following surgical procedures other than thoracic were treated with pancreatic dornase. (Table II.) All of these patients also had thick tenacious sputum which they were unable to raise. They had all had other treatments for the pulmonary complication including antibiotics, potassium iodide, alevaire, other expectorants and in many cases repeated endotracheal aspirations. In many the lesion had actually progressed under these treatments.

In all cases there was liquefaction of the thick sputum with increased ease of expectoration within a few hours of the institution of the treatment. In seventeen of eighteen patients (94 per cent) atelectasis cleared as demonstrated by both clinical signs and roentgenograms.

The following reports are examples of these cases.

CASE III. L. K. (M.H. 14-80-45), a fifty-two year old white woman, was admitted in October 1957 because of dysphagia of two months' duration. This dysphagia had become progressive to the point that she could only swallow liquids. She had undergone radical mastectomy for carcinoma of the breast six years before. Esophagram revealed a narrowing of the mid-esophagus due to an extrinsic lesion. Esophagoscopy revealed a narrowing of the lumen at about 38 cm. from the upper dental arch. A biopsy of the area of stenosis showed metastatic mammary cancer. A gastrostomy for feeding purposes was made on October 4, 1957. Postoperatively the patient was febrile on the fifth day and examination revealed diminished tactile fremitus and breath sounds in the right lateral and anteroinferior lung field. A roentgenogram of the chest on October 9 revealed atelectasis of the middle lobe of the right lung. Bronchoscopy with suction was done on October 10 with no clinical improvement. A roentgenogram of the chest (Fig. 5) on October 11 again showed the atelectasis. Dornase was begun on October 12 giving 100,000 units twice a day. Within forty-eight hours there was a complete objective clearing of the signs of atelectasis and lysis of the fever. A roentgenogram of the chest taken on October 14 showed the excellent result obtained. (Fig. 6.) During this period the tracheobronchial secretions became much thinner and several mucous plugs were coughed up. Treatment was discontinued the next day.

CASE IV. A. O. (M.H. 12-96-37), a fifty-four year old Negro woman, had undergone radical mastectomy with dissection of the internal mammary nodes for carcinoma of the breast in 1954. She remained well until June 1957 when recurrent mammary cancer was discovered. A bilateral oophorectomy was performed on July 15, 1957. Postoperatively moderate abdominal distention was present with an adynamic ileus. On the sixth postoperative day (July 22, 1957), an evisceration of the wound was found and secondary repair performed. The day after secondary repair temperature rose to 102.8°F. and she had great difficulty in expectorating thick, tenaceous mucus. Physical examination revealed diminished tactile fremitus and breath sounds over the lower lobe of the right lung posteriorly. A roentgenogram of the chest on July 24, 1957 (Fig. 7) confirmed the clinical diagnosis of atelectasis of the lower lobe of the right lung. Repeated endotracheal aspirations were unsuccessful in relieving the atelectasis. Dornase was begun, giving 100,000 units in 2 ml. by aerosol three times a day. There was rapid clinical improvement within the first twenty-four hours with expectoration of thinned secretions and plugs of mucus. Examination revealed improved aeration of the lower lobe of the right lung and a roentgenogram of the chest showed the atelectasis was beginning to clear by July 26, 1957. She did not require endotracheal suctioning after the dornase was begun. A roent-

FIG. 5. Case III. Note atelectasis of right middle lobe with elevation of diaphragm. This was taken after bronchoscopy and aspiration failed to relieve obstruction.

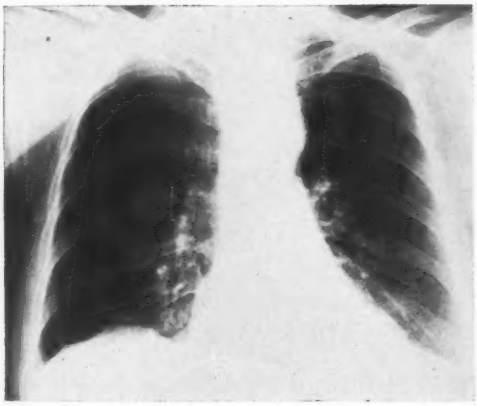

FIG. 6. Case III. After two days of treatment with dornase complete re-expansion is noted.

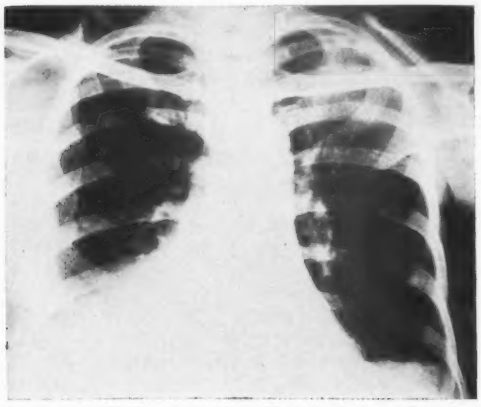

FIG. 7. Case IV. Atelectasis of right lower lobe one day following repair of evisceration. Repeated endotracheal aspirations unsuccessful.

FIG. 8. Case IV. After four days of dornase inhalations. Improvement began on day after treatment started.

genogram on July 29 showed complete resolution of the atelectasis and, therefore, treatment was discontinued. (Fig. 8.)

In thirty patients with segmental atelectasis following abdominal and pelvic surgery the response was equally as gratifying. In this group of elderly patients with segmental atelectasis of the lower lobes of the lung, who experienced great difficulty in coughing or raising thick viscid secretions, the use of dornase aerosol was of marked clinical benefit. It resulted in a drop in temperature, decrease in the respiratory rate and loosening of tracheobronchial secretions. The two patients in whom no effect was noted were both semicomatose and died within three days in coma.

The other twenty-eight patients all had rapid clearing with liquefaction of thick secretions and lysis of temperature in one to two days. There were no toxic effects or side reactions associated with the administration of this aerosol. Although not included in this series many other surgical patients with atelectasis not related to operations were treated with dornase. These included patients with advanced intrathoracic cancer either primary or secondary in whom lobar or segmental atelectasis developed. In these patients atelectasis may be due to blockage of a bronchus by

tumor alone or more frequently to obstruction of a narrowed orifice by mucus. Most of these patients had received x-ray therapy for the carcinoma. Even these symptomatic patients with primary carcinoma of the bronchus with distal atelectasis showed improvement with dornase therapy. Secretions became thinner and were expectorated with ease, and in most cases temperature came down to normal in a few days. This provided palliation in some degree to patients who otherwise had little else available after the course of radiotherapy. In these patients a longer course of therapy was necessary than with the acute atelectasis. They frequently were given 100,000 units one to two times per day for six days to three weeks. Several patients with advanced carcinoma of the esophagus had atelectasis with distal pneumonia secondary to aspiration. In these patients dornase was of great value in facilitating the expectoration of bronchial secretions and clearing of the atelectasis. One patient was found to have metastatic carcinoma to the bronchial mucosa near the carina and despite bronchoscopic removal of part of the tumor, there was frequent bleeding into the trachea with aspiration of blood, atelectasis and pneumonia. In this patient dornase provided a nontoxic agent which loosened the crusts and blood clots and facilitated their expectoration.

There were some instances of atelectasis due to a benign process when dornase therapy was of benefit. These patients usually had an overwhelming medical illness associated with thick tracheobronchial secretions. Dornase liquefied the sputum and allowed easy clearing of areas of focal atelectasis.

No reaction of any type was observed in any of these patients, even those with chronic disease in whom the material was used for up to three weeks. In all patients with acute atelectasis relief was observed within twenty-four hours and in no case was more than three days of treatment necessary.

Other situations in which pancreatic dornase has been found to be particularly effective include post-traumatic patients particularly those with severe trauma to the chest and one patient with a severe burn of the tracheobronchial tree. One patient with multiple rib fractures and old tuberculosis treated with pancreatic dornase has been reported previously.

We have had only one patient with a severe pulmonary burn. He was in respiratory distress due to tracheobronchial crusts and thick secretions and was deteriorating rapidly before dornase was started. Within a few hours the sputum became loose, crusts were expectorated and the patient's condition rapidly improved.

In the majority of patients an increase in the amount of sputum was noted immediately. This would continue for twenty-four to forty-eight hours, and then become markedly diminished as the pulmonary disease cleared. In an occasional patient with a great deal of pulmonary involvement particularly with chronic bronchitis or bronchopneumonia this period of increased expectoration would continue for as long as four days. Patients with atelectasis usually coughed up obvious plugs before clearing of the atelectasis occurred.

An occasional patient with chronic pulmonary disease such as bronchitis, asthma, or bronchiectasis was treated with pancreatic dornase for two to three days before operation and postoperatively, with an obvious improvement in anesthetic management and less than the expected postoperative complications.

COMMENTS

In our experience pancreatic dornase has been the most effective material available for treatment of atelectasis due to plugging of the bronchus by inspissated mucus. In our postoperative patients relief has been rapid and dramatic. In addition to those with demonstrated atelectasis many patients have serious difficulty raising thick ropy sputum because of pain or weakness. With pancreatic dornase the sputum is thinned and can be expectorated without difficulty, thereby relieving the patients wounds and cardiopulmonary system of additional strain. Tracheobronchial aspirations can almost always be discontinued when dornase inhalations are used.

The previously reported observation of an increase in the amount of sputum following dornase therapy has not been observed in these patients, probably because they were in more acute situations generally.

In over 300 patients treated by us there have been no significant reactions. In the patients in the group reported in the present paper no reaction of any degree could be attributed to the pancreatic dornase. This is in clear contradistinction to trypsin, varidase and other enzymes used as inhalations.

It has been feared by many thoracic sur-

geons that enzymes would produce bronchial fistulas. Theoretically this need not be feared if the bronchus was adequately closed since none of these enzymes will effect living tissues or suture materials. In our experience with this and other enzymes there has never been any evidence of development of a bronchial fistula.

SUMMARY

1. One hundred twelve patients with atelectasis or other serious pulmonary complicaplications of surgery were treated with pancreatic dornase aerosol.

2. No toxic or allergic reactions or undesirable side effects were noted.

3. Resolution of the atelectasis or other complication resulted in 91 per cent of patients. Improvement can be expected in a few hours and relief is usually complete within one to three days of treatment.

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The Repair of Interatrial Defects Through a Right Anterolateral Thoracotomy

A METHOD FOR CONTROLLING A PERSISTENT LEFT SUPERIOR VENA CAVA

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A right anterolateral incision provides a convenient approach for the repair of interatrial septal defects with the mechanical heart-lung apparatus. However, occasionally, there is a persistent left superior vena cava which drains blood of the left innominate vein directly into the right atrium via the coronary sinus. Because a persistent left superior vena cava cannot be reached for temporary occlusion through a right thoracotomy, innominate (caval) venous blood will pour forth into the operative field when the right atrium is opened. Such an event would divert the blood from the catheter in the right superior vena cava and compromise the perfusion.

Because the right anterolateral incision has proved to be the most convenient approach to the repair of both ostium primum and secundum lesions, a simple technic has been devised for managing those patients in whom an associated persistent left superior vena cava is found at operation.

OPERATIVE METHOD

The patient is placed in the supine position with the right side elevated about 30 degrees. (Fig. 1.) The usual inframammary incision is made, the pectoralis major is divided near its insertion into the thoracic cage, and the chest is entered through the fourth interspace. Occasionally, in adults, the right fourth costal cartilage is divided at the sternum. The lung is retracted posteriorly behind pads and held in place by traction sutures placed at intervals along the posterior edge of the pericardium which has been incised anterior and parallel to the phrenic nerve. The anterior edge of the pericardium is tacked temporarily to the inside of the chest wall. In children, the thymus must first be reflected off the pericardium overlying the base of the great vessels.

The size of the right superior vena cava offers the first clue to the presence of a persistent left superior vena cava. When a persistent left superior vena cava is present, the right vena cava is abnormally small in diameter. The diagnosis is confirmed by an additional step undertaken while the right atrium is being prepared for caval cannulation. The index finger is introduced into the right atrium, via one of the intended sites of insertion of the catheter, and the coronary sinus ostium is sought. The presence of a markedly enlarged coronary sinus, large enough to accept the index finger, confirms the presence of a persistent left superior vena cava.

A Foley catheter (18 to 24 French), with a self-sealing bag, is prepared. A syringe containing 20 cc. of saline solution, with its needle inserted into the self-sealing adapter, is held in readiness. After total bypass is established, the

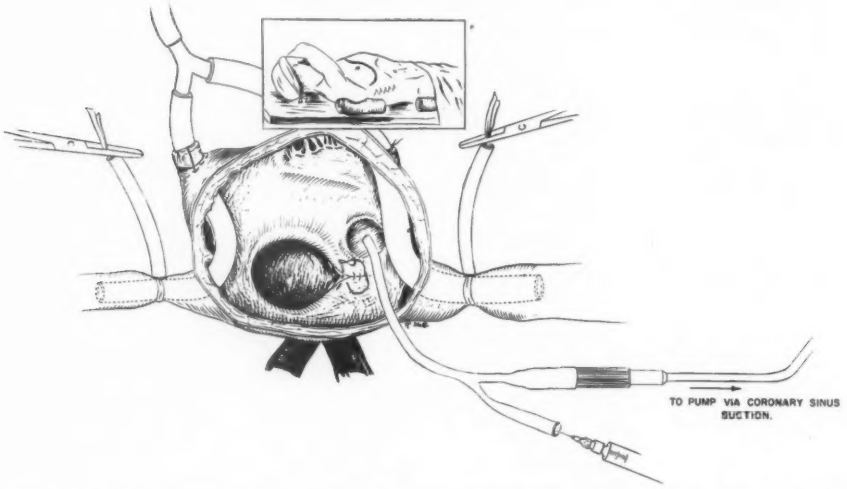

FIG. 1. This drawing shows the opened right atrium with the Foley bag in place and inflated in the coronary ostium. The coronary ostium in those patients with persistent left superior vena cava is large and easily accommodates the index finger. The inset shows the positioning of the patient and the operative incision.

right atrium is opened and the catheter is introduced into the coronary sinus. (Fig. 1.) The first assistant inflates the bag to the proper tension. The other end of the catheter is then pulled over one of the coronary sinus suckers. The repair of the defect then proceeds in the usual fashion. At the conclusion of the intracardiac repair, just before completing the closure of the atrial incision, the bag is deflated and the catheter is withdrawn.

COMMENTS

The operative incision has been employed in sixty-one cases of secundum and ostium primum defects. A persistent left superior vena cava has been encountered in five instances. The technic that has been described herein has proved to be most satisfactory for both types of defect. The presence of the inflated balloon does not interfere with repair or cardiac action. The rim of the coronary sinus prevents the inflated bag from slipping out. The blood of the innominate vein and coronary sinus is returned to the apparatus in a controlled fashion and the perfusion proceeds satisfactorily.

SUMMARY

A right anterolateral incision has proved to be a most satisfactory operative approach for repair of secundum and ostium primum defects. Its only disadvantage is the unexpected presence of a persistent left superior vena cava which cannot be controlled from a right thoracotomy. However, a technic has been successfully employed in sixty-one cases that adequately deals with the large volume of blood draining into the coronary sinus when a persistent left superior vena cava is encountered at operation. The method consists of cannulating the coronary sinus with a Foley catheter which is then connected to one of the coronary sinus suction lines. This insures a satisfactory perfusion and provides a clear operative field for repair of the defect.

Thiersch's Operation for Rectal Prolapse in Infants and Children

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RECTAL prolapse is the condition in which part or all of the rectum protrudes through the anal orifice. This is one of the most common lesions of the rectum occurring in infants and young children. It can be observed at any age. Wilklander reports 10 per cent of his series in adults [12]. The majority of cases occur between the ages of one and three years.

Prolapse is partial when there is protrusion of the mucous membranes only beyond the sphincter or complete when there is evagination of the rectal wall for a variable distance, usually 5 to 8 cm. The rectum is everted and projects as a pink or purple mass from the anus. Partial prolapse occurs more frequently.

ETIOLOGY

The etiology of rectal prolapse is multiple. There are various anatomic factors as well as mechanical conditions predisposing to rectal prolapse.

Anatomic Factors. The anatomy of the anorectum in infants differs in certain essentials from that in adults [9]. In the newborn the sacrum is straight. The ilia are flat and do not develop their normal concavity until the child grows older. The rectosigmoid and rectum form a straight line rather than the curved configuration present in an older child. The valves of Houston are absent or poorly developed. Fusion of the rectal wall to the aponeurosis of Denonvilliers is incomplete. The pelvic organs, such as the bladder and the uterus, are in a higher position in children than in adults, being abdominal rather than pelvic in position. Anatomic dissections have demonstrated the lateral ligaments of the rectum to be poorly developed in children. As the infant grows older the pelvic canal gradually changes from a vertical plane and inclines more toward the horizontal. Simultaneously the sacrum becomes more curved, thus elongating the pelvic canal. These anatomic changes which result in the rectum assuming curved position in the pelvis probably account for the smaller incidence of prolapse in older children and adults. (Fig. 1.) In exstrophy of the urinary bladder there is separation of the pubic bones and an inefficient pelvic floor [7]. In such infants, particularly females, prolapse may be constant [8]. Six of nine cases which we have treated surgically fell into this group.

Mechanical Factors. There are many diseases which cause undue straining in infants and children predisposing to rectal prolapse. One of the most common causes is hyperactivity of the intestine such as in diarrhea. The greater force exerted by a constipated child may be a contributing factor. Likewise obstructive disorders in the lower urinary tract may be a causative factor.

Tordoir [10] emphasized the significance of loss of perirectal fat due to malnutrition. While the lesion is more common in children with malnutrition, the condition is also found in well nourished and otherwise perfectly healthy children.

PATHOLOGY

The apex of the prolapse is always pointed somewhat posteriorly due to the greater length of the anterior wall as compared to the posterior wall. The protruding mass may vary in color from bright red to deep purple and in size from a rosette measuring 1 cm. to a cylindrically shaped tumor measuring 12 cm. The mucosa is usually arranged in a series of thick circular folds and is congested and edematous.

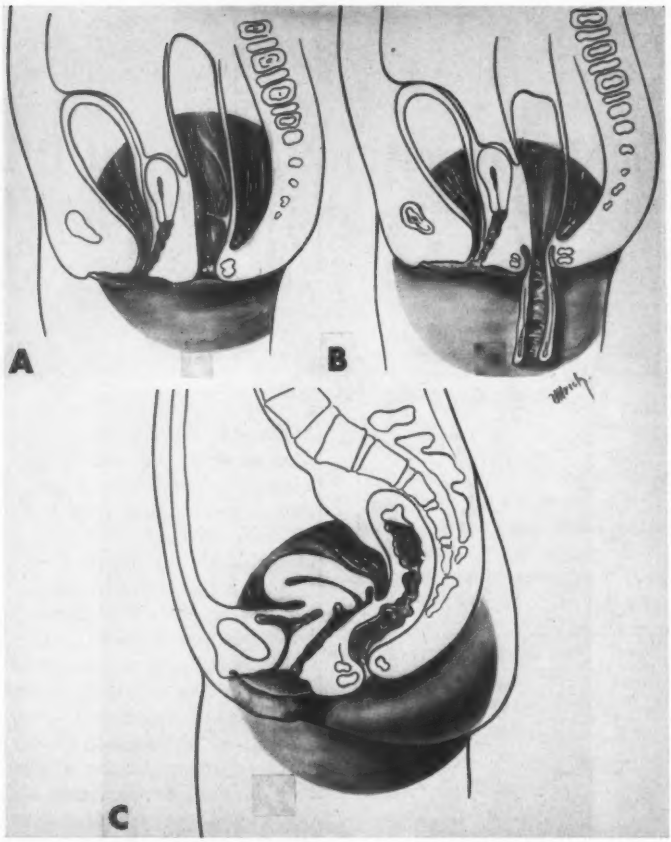


FIG. 1. A, sagittal section through the pelvis of an infant; note the straight course of the rectosigmoid and rectum through the pelvis. B, increase of intra-abdominal pressure readily produces prolapse with these anatomical conditions. C, note the normal adult relationship of the rectosigmoid to the sacral curvature.

CLINICAL FEATURES

Rectal prolapse usually occurs during the act of defecation and alarms the child and the parents. The diagnosis is easy but may be missed in the patients with intermittent prolapse unless the child is asked to strain to produce the prolapse. In severe cases the prolapse is constant. Irregular bowel movements, incontinence and mucous discharge are common complaints. Thirty-six per cent have slight rectal bleeding [4].

The possibility of an acute or chronic recurring ileocecal intussusception at the anus has to be kept in mind. The condition can be differentiated by careful local examination. In prolapse the projecting mucosa will be felt to be continuous with the perianal skin; whereas, in intussusception the examining finger passes into the sulcus between the intussusception and the surrounding anal sphincter. Occasionally, a rectal polyp simulates a prolapse or initiates it.

Proctologic examination of these infants and children usually reveals absence of other rectal disease [4]. If the prolapse is not replaced, there is a danger of edema followed by ulceration or rarely gangrene of the exposed mucosa. The prolapsed mucosa frequently shows signs of superficial infection and ulceration. Severe

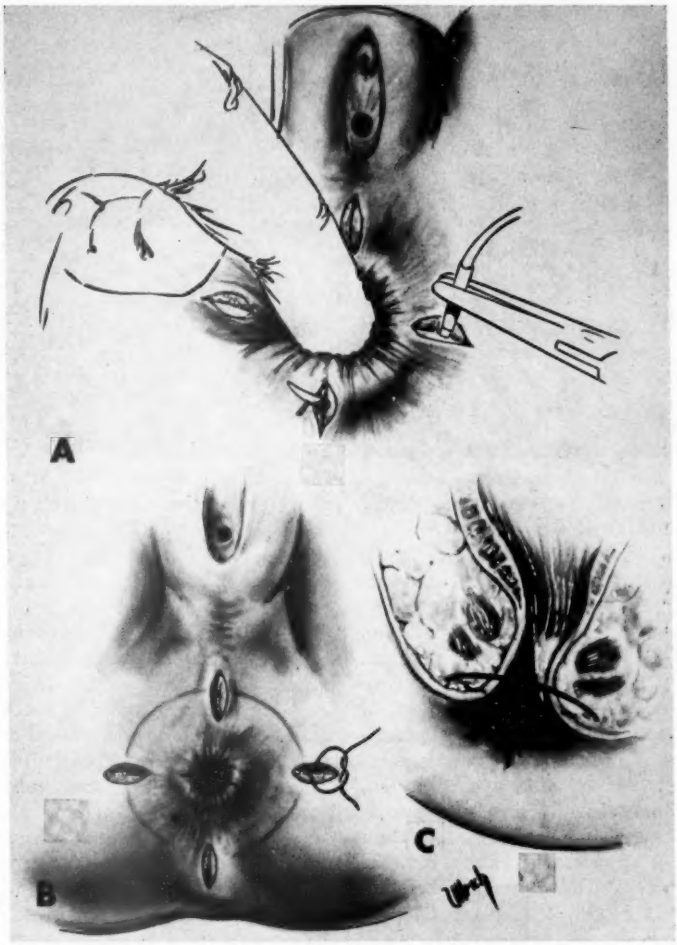


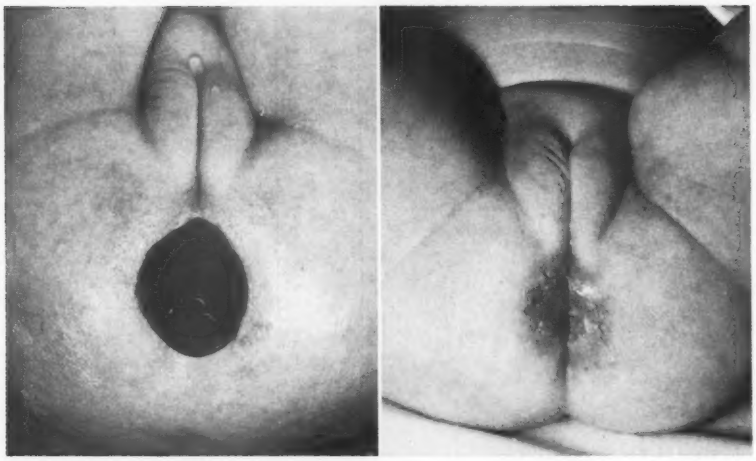
FIG. 2. Semischematic drawing of Thiersch's operation: A, the nylon suture has been passed from the first to the second incision subcutaneously. B, the suture now is placed circumferentially around the anus. C, sagittal section showing the structure in the subcutaneous tissue, avoiding the external sphincter.

hemorrhage from rupture of one of the dilated submucosal veins may occur. Thrombosis and obstruction of the venous return produces edema of the mucosa. In long-standing cases, a proctitis develops and the mucosa may lose its circular folds and become smooth and bright red with excess mucous secretion. The protruding mass, by the frequency and constancy of its pressure, stretches and weakens the sphincter until it may no longer react normally and the patient finally may become incontinent.

TREATMENT

The treatment of rectal prolapse in children should be directed toward the cause as Hippocrates [*11*] first advocated.

Because there is a tendency toward spontaneous healing, conservative methods of treatment were used through the centuries. Conservative therapy is directed towards reducing straining by the use of stool softeners and training the patient to have bowel movements on the bedpan while lying down. For the more



3A 3B

FIG. 3. A, rectal prolapse in an infant with meningomyelocele. B, photograph of same patient after Thiersch's operation.

severe cases strapping of the buttocks together with adhesive tape may be required. Strapping is continued between defecations for a period of several weeks in an effort to prevent recurrence.

During the last four decades numerous procedures have been used for the treatment of rectal prolapse in children. Lineal cauterization, submucous injection of sclerosing solutions such as quinine and urea hydrochloride, perirectal injections of alcohol and intramuscular injections of thiamine have been advocated.

None of these procedures have been entirely satisfactory. Conservative treatment is successful in the majority of cases. When rectal prolapse is due to anatomic defects such as in exstrophy of the urinary bladder and meningomyelocele, conservative treatment is usually not successful and the procedure of Thiersch gives satisfactory results.

Thiersch's Operation. This operation consists of surrounding the anus with a ring of silver wire. The principle of the wire ring of Thiersch is to prevent the escape of the prolapse by narrowing the anal opening. Thiersch first described this method in 1891. He believed that this operation was effective partly due to the mechanical support given by the ring and partly as a result of fibrous tissue deposited locally as a reaction to the ring. He used wire and recommended that it be removed after three months. Since the first description of the procedure, numerous modifications have been made [*13*], using a diversity of material such as silk, strips of fascia lata, tendon, and rubber. A number of papers have reported satisfactory results in the European literature [*1,5*].

In England the Thiersch method was first used by Bell in 1910; but according to Gabriel [*2*], has never been accepted as a useful operation. In this country Platt [*6*] (1896) modified the method for the treatment of prolapse in children.

Technique of Modified Thiersch's Operation. Under general anesthesia the patient is placed in lithotomy position and the perineum is scrubbed with pHisoHex® and aqueous Zephiran® and draped. The prolapse is easily reduced by the assistant who keeps his finger in the anal canal during the operation. Four small incisions are made through the skin with a knife, 1 cm. from the mucocutaneous junction laterally. (Fig. 2.) A suitable length of sterile braided nylon No. 1 is threaded on a large curved non-cutting needle of the Mayo type and is passed around the perianal space subcutaneously, utilizing the four incisions to insure proper placement of the sutures. The two ends of the braided nylon suture are then carefully tightened while the assistant keeps his finger in the anal canal and reports when the suture is sufficiently tight to admit the forefinger comfortably. It is important that the ring not be too tight. Each of the four skin incisions are sutured over the buried nylon

ring with interrupted No. 5-0 plain catgut suture and sealed with flexible collodion. Postoperatively, the anus is constricted to a size which will allow a soft stool to pass but will not allow the rectum to prolapse. (Figs. 3A and B.) The operation has been successful in preventing prolapse in our nine patients. The only complication was in our first, when a catgut suture which broke ten days after operation was used. This complication has not occurred with the use of nylon.

COMMENTS

Conservative treatment of rectal prolapse in infants and children has been known since ancient times and should always be instituted first. This will be successful in the majority of cases. In 14 per cent of all cases, rectal prolapse persists beyond childhood [4]. Hayden [3] reported several adults whose symptoms dated back to childhood. Consequently, if the child is more than four years old, the percentage of recurrence is high with conservative therapy and these should be considered for the Thiersch's operation.

When conservative methods are used, the tendency to recurrence is highest during periods of constipation or diarrhea. Some authors recommend the injection method of treatment. These have not been entirely satisfactory due to the associated pain and discomfort, particularly when alcohol is injected and converts the prolapse from a painless to a painful condition. Complications such as infection have been reported.

The method of Thiersch is ideal for children with exstrophy of the urinary bladder and meningomyelocele and persistent prolapse in normal children. We have used the operation in nine cases. It is a simple procedure, requiring only a day's hospitalization and being virtually without complications. Six cases were associated with exstrophy of the bladder; one was meningomyelocele; one had fibrocystic disease of the pancreas with pulmonary involvement and one had severe idiopathic prolapse. Conservative treatment was unsuccessful in all of these. The success of the operation is probably due to the fact that the ring brings the sphincter and pelvic floor higher and gives it a chance to contract normally. The complications which in the past were described from a break of the Thiersch silver wire and the formation of fistulas and perirectal abscess are avoided with the braided nylon and by the use of strict aseptic conditions during insertion of the suture.

The Thiersch operation was also successfully applied as a subcutaneous suture around the ileostomy to prevent prolapse.

SUMMARY

Prolapse of the rectum is a relatively common condition in infants. The treatment is directed toward the cause. If conservative methods do not give good results, an operation may be necessary. If the cause of prolapse is due to anatomic defects such as in exstrophy of the bladder and meningomyelocele, surgical therapy should always be used. The method of choice is the Thiersch operation.

This method may also be useful in the treatment of recurrent prolapse of the intestine through an ileostomy.

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A "New" Approach to the Treatment of Hernias of the Groin

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THE subject of the present paper can best be introduced by recounting an experience had in the winter of 1939 to 1940 during an operation upon an elderly man for a ureteral calculus which had lodged near the right vesicoureteral junction. He had also had a complete, scrotal hernia of long-standing for which he had always refused operation. When the peritoneum was stripped away from the posterior abdominal wall in the customary approach to the distal ureter, it came away so easily that it seemed feasible to reduce the hernial sac at the same time. This was performed. All the redundant peritoneum was removed from the iliac fossa and urinary bladder and resected, and the remaining defect in the peritoneum and fascia was closed. The calculus was then removed and closure of the wound made in the usual way.

Although this patient had had a defect or weakness of the abdominal wall large enough to admit a small fist, in four or five weeks it was difficult to tell that a hernia had ever been present. This patient was followed up over a period of seven years, until death, and there was no recurrence of the hernia.

This incident occurred at a time when I was engaged in operating upon a number of patients with hernias without repairing the abdominal wall, the results of which study have been reported [9]. The technic used was as follows.

The inguinal canal was opened by an incision parallel to and a fingerbreadth medial to the inguinal ligament. After freeing the cord from its bed, its coverings were incised on the anteromedial aspect thus exposing the neck of an indirect sac or the small remnant of the processus vaginalis, which appears as a dimple at the internal ring when viewed from within the abdomen. After the peritoneum in this location was grasped, and held taut with forceps, the vas deferens was stripped from its surface down as far as the crossing of the ureter. The sac was then opened and accessory sacs located. A considerable number, if not the majority, of hernias of the groin are multilocular.

With a finger within the sac and with considerable traction put upon it, the sac was dissected free of surrounding structures, including the bladder, until all accessory sacs and all redundant peritoneum had been reduced to the position of an indirect sac. Dissection was considered complete when the direction of the peritoneum extending from the base of the sac was directly posterior rather than inferior.

After this rather radical freeing of peritoneum the abdominal cavity was closed and excess tissue removed. The excess fascia transversalis, particularly noticed with direct hernias, was removed next and the defects remained closed. The incision in the abdominal wall was then closed, as it had been opened, with no attempt at a plastic repair. I had been led to try this technic after observation in the operating room, the autopsy room and the anatomic laboratory which had led me to certain conclusions: (1) Hernias which were saccular had to be distinguished from ruptures. (2) Hernias are only seen when a blood vessel or a viscus has passed through the body wall. (3) In the normal abdominal wall, frequently, peritoneal dimples are seen overlying the internal ring or femoral canal, or in Hesselbach's triangle when the inferior (deep) epigastric vessels perforate the transversalis fascia. In these same locations are found sheaths of transversalis fascia prolonged with the vessels. A constant and prominent example is the femoral sheath. (4) A great many, probably the majority, of hernias of the groin are multiple. There seems to be a hernial diathesis.

(5) From the aforementioned it appeared that hernias were congenital and the defect was in the peritoneum and transversalis fascia rather than the abdominal wall, and if the excess of the aforementioned layers were removed a permanent cure should result. Of 167 hernias in 140 patients treated in this way, with a follow-up period of thirteen years, only four failures were encountered [9,10].

The experience with the treatment of the patient with the urinary calculus tended to confirm the belief that a repair of the abdominal wall was not necessary, and the ease with which an adequate dissection of peritoneum and transversalis fascia was accomplished transabdominally was impressive. These tissues could be dissected by sight rather than by feel as had to be done to some extent in the inguinal approach.

REVIEW OF THE LITERATURE

The literature was surveyed to see if anybody else had had a similar experience, and it was found that a number of papers had been published. In 1909, Robins [11] of Virginia had reported on a method of treating strangulated hernia through a rectus incision and LaRoque [6] reported that he had been performing a transabdominal operation for hernia for seven years prior to 1919 when he read a paper on his method before the Richmond Surgical Society. He made the usual inguinal incision but then approached the sac from within the abdomen by opening the peritoneum 1½ to 2 inches above the internal ring through a muscle-splitting incision of the internal oblique and transversus abdominis muscles, such as in a McBurney approach to the appendix. In this and subsequent papers [6–8] he reported the performance of over 1,500 such operations, resulting in a cure rate far superior to the 5 to 20 per cent encountered even today.

A paper by Banerjee [1] of Calcutta, India, was intriguing. He approached hernias of the groin through a subumbilical median incision. He did not make any attempt to remove the sac but got rid of redundant peritoneum and hernial sacs by imbricating and oversewing. He made no repair of the abdominal wall. In the sixty-six patients he operated upon in this manner there were no recurrences.

Encouraged by the papers of these men I determined to perform this procedure at every feasible opportunity. At first the operation was limited to patients who needed a pelvic laparotomy and also had a hernia of the groin. It was then extended to patients who had a large incarcerated or strangulated hernia or to patients who, it was fairly sure, had a sliding hernia. Later on it was used, from time to time, in the routine hernia. The present paper is a report of the experience with this operation in the twenty years that have passed since the first one was performed.

The technic used differs from that of LaRoque and his followers [4,13] in that an inguinal incision is not used and no repair of the so-called defect in the abdominal wall is made. The technic also differs from Banerjee's in that an attempt is made (successful in the largest proportion) to remove the sac or sacs and redundant peritoneum. The approach used is through a transverse or paramedian incision in the lower quadrants. All diverticula of the peritoneum and transversalis fascia and redundant portions thereof are removed. In the majority of cases this has been quite easily accomplished but in several the sacs were allowed to remain after their orifices were excluded from the abdominal cavity. In none of these latter cases did ill results ensue. Therefore, it is believed that removal of the distal sac is probably not necessary.

The treatment of sliding hernia is so facilitated by this approach that had it no other merit, this alone would serve to insure its use. The hernial sac, together with the attached bowel, is reduced into the abdomen. The bowel is freed from the sac by incising the lateral peritoneal reflection much as one handles a massive prolapse of the rectum from above, or begins the dissection of the colon for resection. The bowel is then sutured in its place in the abdomen, the remaining sac is removed and the defect in the peritoneum and fascia overlying the ring closed.

The hernias that have been repaired through transabdominal incisions are not many; there are thirty-eight in all. However, it is significant that there have been no recurrences. The shortest follow-up period is four years, about equally divided between letter and direct examination.

From these cases, in which the inguinal canal was not entered, and from the hernias removed without repairing the abdominal wall [9,10], I have come to the belief that surgeons have become "lost in the trees" of abdominal wall repair and have "missed the woods" of the true cause of hernias, which is the congenital

presence of diverticula of peritoneal and extraperitoneal tissue. I am not the only one, or the first, to hold this belief.

Bloodgood [2], in a monograph on hernia published in 1899, outlined Halstead's hernial operation, two steps of which I quote here: (1) The incision begins at the external ring and ends 1 inch or less to the inner side of the anterior superior spine of the ilium on an imaginary line connecting the superior spines of the ilia. *Throughout the entire length of the incision everything superficial to the peritoneum is cut through.* (2) The abdominal cavity is closed by mattress sutures passed through the peritoneum at a higher level by 1½ inches than that of the so-called neck of the sac.

Does this mean that Halstead cut the internal oblique and transversus abdominis muscles for 1½ to 2 inches above their arching margin to allow an approach to the peritoneum in this area?

LaRoque made quite a point, as mentioned previously, of splitting these muscles at least 1½ inches above the internal ring to permit an intra-abdominal approach to the hernial sac.

Again, Halstead [3], believed that "little of the original operations of Bassini and himself was essential except a clear and free exposure of the entire canal which makes possible the high ligation of the sac. The transplantation of the cord and the attempt (quite futile) to re-establish the obliquity of the canal may be omitted; even the suture of the internal oblique muscle to Poupart's ligament may prove to be an unnecessary detail" and Taylor [12] himself believed that such was the case.

LaRoque also believed that the total removal of the sac or sacs and the redundant peritoneum was the real essential and wondered about the importance of the plastic repair of the abdominal wall.

Lameris [5] has reported some experiments on patients which led him to believe that repairs involving deep tissues, except for the peritoneum and extraperitoneal fascia, were useless.

Reference has already been made to the sixty-six patients of Banerjee who had no recurrence even though the inguinal region had not been entered, far less repaired.

Not only do I believe that a repair of the abdominal wall is unnecessary but also that it may be harmful and predispose to recurrence of disease. When a muscle is held immobile, as when the conjoined tendon of the internal oblique and transversus abdominis is fixed to Cooper's ligament, it atrophies and loses its function. The protective function of the arched portion of these muscles is taken over by a thin sheet of poor quality musculofascial tissue, which easily allows unremoved diverticula of peritoneum to protrude as a so-called recurrence. In the same paper by Taylor [12] previously quoted, he states that, "From the figure below it seems that the percentage of recurrence is very much higher in those cases in which the cord is transplanted . . . "

There is one main disadvantage of the intra-abdominal approach to the treatment of hernias of the groin. This is the difficulty of having the patient, or the agency referring him, accept the presence of a laparotomy wound for the cure of a "mere rupture." The wider opening of the peritoneal cavity has in this modern day no validity as an objection.

This operation is not advocated for the routine hernia because it is believed that an adequate dissection can be made through the usual inguinal approach. However, it is recommended in the treatment of complicated or difficult hernias, those which are incarcerated, strangulated, or sliding.

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Hemostasis in Retropubic Prostatectomy

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TEN years have elapsed since Millin's introduction of retropubic prostatectomy [1–3] to the American urologist. However, early enthusiasm for this novel operation has waned as a result of numerous complications, including bladder neck contracture, urinary incontinence, suprapubic urinary fistula, and osteitis pubis. On the other hand, proponents of retropubic prostatectomy have demonstrated that these complications are distinctly infrequent. However, one complication that seems to prevail is operative blood loss.

This paper illustrates the surgical significance of the vascular topography encountered in retropubic prostatectomy and describes the operative technique for accomplishing prompt and effective hemostasis.

ANATOMIC CONSIDERATIONS

The vascular networks involved in retropubic prostatectomy are the periprostatic veins, the capsular arteries, and the prostatic arteries.

The periprostatic veins lie in a fatty shelf covering the prostatic capsule. They run longitudinally in the region of the midline or along the lateral borders of the prostatic capsule to their disposition on the bladder. The periprostatic veins may be considered as the framework of support for the fatty shelf above the prostatic capsule. Division of the veins permits easy reflection of the fat from the prostatic capsule. They are derived from the deep dorsal vein of the penis which retracts beneath the symphysis when cut. The deep dorsal vein also may be obscured by the puboprostatic ligament.

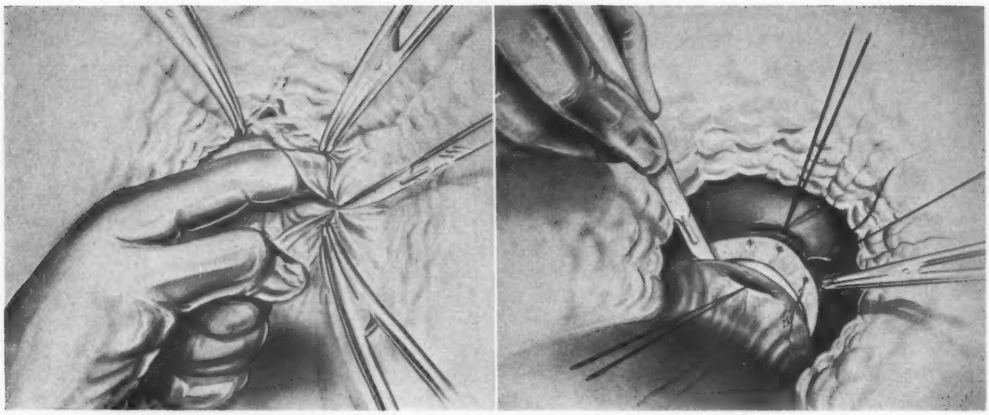
The capsular arteries lie within the thick surgical capsule of the prostate. After a transverse incision is made in the prostatic capsule, distinct spurting arteries are seen. These are derived from the prostatic or inferior vesical artery.

The prostatic arteries are large offshoots of the inferior vesical arteries which penetrate the bladder neck in the regions of five and seven o'clock.

TECHNIC

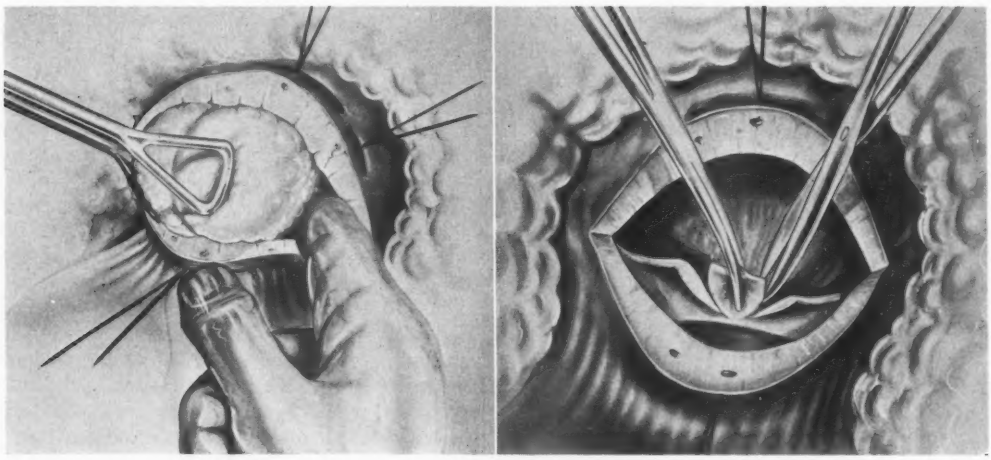
The patient is placed in slight Trendelenberg position with elevation of the symphysis pubis. A midline suprapubic incision is made beginning at the base of the penis. The rectus fascia is incised, and the muscle is separated in the midline by blunt dissection. A medium size Balfour retractor without the middle blade is placed in the prevesical space. The prevesical fat and fascia are reflected from above gently downward in the midline of the collapsed bladder down to the region of the prostatovesical junction with a gauze sponge forceps. The perivesical veins encountered are either avoided or clamped and sealed with coagulation current. Symmetrical pressure is applied downward with two gauze sponge forceps on the collapsed bladder just above the prostatovesical line. The operator holds one of the forceps with his left hand and the assistant holds the other with his left hand. Then the fatty shelf is reflected off the prostatic capsule, and a small area of prostatic capsule, about 2 cm. in depth and 3 cm. in width is exposed. The lateral prostatic recesses are not disturbed. The periprostatic veins, if present, will tear upon reflection of periprostatic fat. They are divided between clamps and each clamp touched with electrocoagulation current. This is done near the prostatovesical junction. The periprostatic fat is then easily reflected off the prostatic capsule (Fig. 1A).

A midline ligature stay suture of No. 1 chromic catgut is inserted about 2 cm. below the prostatovesical line, incorporating the entire thickness of the surgical capsule of the



1A 1B

FIG. 1. A, periprostatic veins are sealed with electrocoagulation. The fatty shelf is demonstrated. B, suture ligature of capsular arteries incorporates full thickness of capsule.

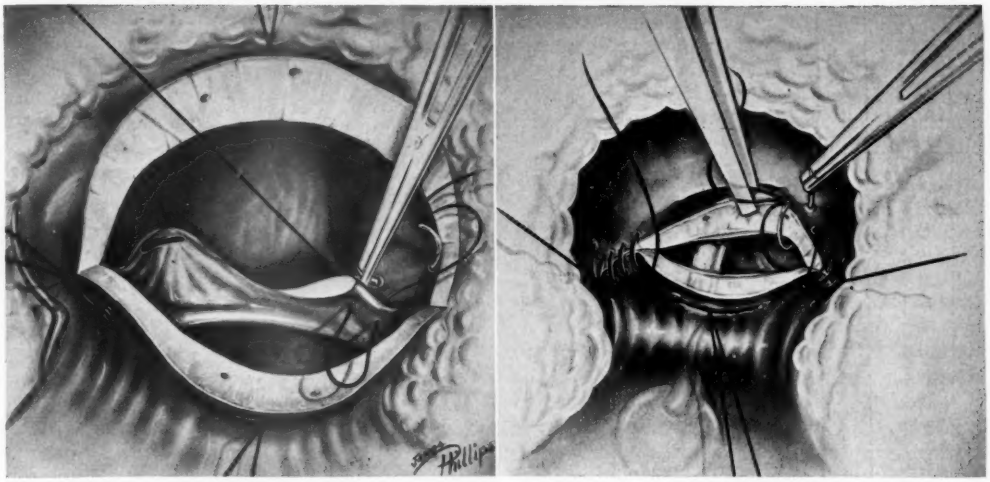


2A 2B

FIG. 2. A, enucleation is developed closely on adenoma. B, wedge resection of posterior lip of bladder neck permits introduction of two fingers into bladder.

prostate. Another midline ligature stay suture is placed about 1 cm. proximal to the initial stay suture. In the case of a large adenoma, similar sutures are taken lateral to the midline sutures. A slightly elliptical transverse incision about 2 cm. in length with the concavity toward the bladder side is made between the stay sutures and extended down to the adenoma. An Allis clamp is temporarily applied to the incised capsule where a spurting capsular artery is seen, and a ligature is taken at that site through the entire thickness of the surgical capsule (Fig. 1B).

The prostatic adenoma is enucleated gently in a cleavage plane as close as possible to the adenoma. The apex is freed upward with care to avoid avulsing the mucosa of the membranous urethra; one lobe at a time is delivered from the prostatic bed (Fig. 2A). The mucosal attachments of the adenoma are excised at the bladder neck, and all mucosal tags are removed. A warm pack is temporarily placed in the prostatic cavity and then a Kelly clamp is placed in the region of five and seven o'clock at the bladder neck. A generous wedge of tissue is removed from the posterior lip of the



3A 3B

FIG. 3. A, ligation of prostatic artery with sutures at angle of bladder neck and prostatic bed and at angle of incised capsule. These sutures closely approximate each other. B, each ligature at angle of capsule is continued as a running suture and includes the entire capsular thickening and rim of bladder mucosa. They are tied in midline of capsule.

bladder neck to allow two fingers to pass freely into the bladder cavity (Fig. 2B).

A suture of No. 1-0 chromic catgut is placed at five and seven o'clock at the bladder neck. It begins on the side of the prostatic cavity, incorporates the full thickness of the bladder neck ridge, and grasps the mucosa of the bladder as a mattress suture. This is extended into the depth of the posterolateral surface of the prostatic fossa floor as a transverse suture and tied in the prostatic cavity. A suture of No. 1-0 chromic catgut is then taken at each angle of the incised prostatic capsule, running in close approximation to the previously placed bladder neck suture, and tied on the outside of the capsule (Fig. 3A).

A No. 22 French Foley catheter with a 5 cc. bag is inserted into the bladder via the external urethral meatus. The bag is inflated with 10 cc. of water and left in the bladder cavity. Each angle suture is continued as a running suture for closure of the prostatic capsule; they join in the midline where they are tied. The entire capsular thickening and rim of bladder mucosa are included in the suture (Fig. 3B). One Penrose drain is placed in each lateral recess of the space of Retzius and brought out through the lower angle of the wound. Interrupted No. 1-0 chromic catgut is used for closure of muscle and fascia.

POSTOPERATIVE MANAGEMENT

The return of irrigating fluid at the conclusion of the operation usually is clear, but the urine may contain blood for twenty-four to forty-eight hours. The catheter is irrigated with normal saline every eight hours for twenty-four hours unless there is evidence of impaired drainage, requiring more frequent irrigation. The Penrose drains are shortened daily from the first to the fifth postoperative day. The Foley catheter is removed on the fifth postoperative day and the skin sutures are removed on the sixth or seventh postoperative day when the patient is discharged. The patient is allowed out of bed on the first postoperative day and given a regular diet. A sulfonamide is prescribed for two weeks.

RESULTS

In seventy consecutive private cases of retropubic prostatectomy which I performed in Columbus Hospital from 1953 to 1959, significant observations related to blood loss were evident. I used standard technic, and all but four patients received spinal anesthesia. Sixty-four of the operations (over 90 per cent) were performed in less than one hour of operation time. The weight of the adenomas removed ranged from 40 gm. to 210 gm. Fifty-

eight patients (over 80 per cent) were discharged on or before the seventh postoperative day. There was one death due to acute myocardial infarction on the fifth postoperative day; however, none of the patients required a blood transfusion.

COMMENTS

The prevesical approach to the prostatic capsule avoids the posterior surface of the symphysis pubis and the complexities of the periprostatic veins and permits easy manipulation in an accessible area of the space of Retzius. However, the prevesical fat and fascia on the anteroinferior border of the collapsed bladder must be initially reflected in the midline from above downward and the periprostatic fascia secondarily approached. The immediate retropubic or paraprostatic spaces are not entered and the fat-covered veins, unavoidably torn when reflecting retropubic fascia from behind the symphysis, are not encountered. In such a retropubic approach, visualization, clamping, ligation, or electrocoagulation of bleeding vessels is often a formidable problem. However, the lateral prostatic plexuses of veins are not disturbed by packs, the puboprostatic ligament which lies over the deep dorsal vein of the penis and its bifurcation is not incised, and a large portion of the prostatic capsule is not exposed.

The most delicate step in any form of the Millin type of retropubic prostatectomy is the approach to and exposure of the prostatic capsule. It is at this time that the vascular topography must be scrutinized carefully. Obscure veins enmeshed in retropubic fat and inadvertently torn during manipulation can cause extremely troublesome bleeding and hemorrhage. Repeated attempts to identify retracted, fat-covered, bleeding vessels become time consuming. One surgeon encountered so much bleeding that he had to pack the space of Retzius for seventy-two hours. He never approached the prostatic capsule and finally performed a cystotomy. Osteitis pubis developed. The surgeon deliberately incised the puboprostatic ligament near the symphysis pubis and inadvertently divided the deep dorsal vein of the penis. Retraction of the cut end of this large vein beneath the symphysis made clamping impossible.

The puboprostatic ligament usually blends into the visceral endopelvic fascia of the prostate around which the periprostatic veins lie. The ligament should be incised only on the superior border of the prostate, if the ligament attaches to the bladder.

Gentle reflection of prevesical fascia on the bladder wall from above downward in the midline is of paramount importance until the prostatovesical junction is identified. Blood vessels are evaded or clamped and sealed with electrocoagulation under vision, providing the ideal management.

A high incision in the prostatic capsule is desirable. Such an incision remains proximal to the bifurcating branches of the deep dorsal vein of the penis and permits easy closure of the prostatic capsule. A slightly elliptical transverse incision with the concavity toward the bladder side will favor cephalad tearing of the capsule, if tearing occurs on enucleation of large adenomas, and evasion of the lateral prostatic venous plexuses. The capsular incision should not bevel the thickness of the surgical capsule, because more capsular arteries would be incised. The spurting capsular arteries are ligated by a capsular suture or temporarily sealed by grasping the capsule with an Allis clamp and ligated with the running sutures used to close the capsule.

A significant advance in the control of bleeding is suture ligatures at the angle of the posterior ridge of the bladder neck and prostatic cavity and the angle of the incised prostatic capsule. These sutures closely approximate each other, and hemostasis is virtually complete following this step.

All methods of prostatectomy, properly performed, have a common objective and equally good results. However, there is considerable variation in each patient's operative and postoperative course. The operative technic for accomplishing hemostasis and the measures required to control postoperative bleeding are often the predominant factors related to the absence or presence and the extent of undesirable or complicating events. These include longer operating time, use of blood transfusions, restoration of circulatory efficiency, added stress on the patient who is a poor risk for surgery, frequency of catheter irrigations, impaired catheter drainage, evacuation of clots, catheter bag traction, return to the operating room, added sedation, acute pyelonephritis, delayed ambulation, prolonged catheter drainage and hospitalization.

The merit of retropubic prostatectomy stems from effective hemostasis. Complete adenomectomy and accurate hemostasis with clear visualization distinguish this method of prostatectomy, and it is a step forward in prostatic surgery. However, failure of this method to achieve this objective eliminates the greatest share of its value.

SUMMARY

Assets of retropubic prostatectomy are short operating time, catheter drainage, and hospitalization. These are combined with a benign postoperative course, early ambulation, and good functional results.

However, the outstanding attribute of retropubic prostatectomy is prompt and effective hemostasis accomplished with clear visualization to insure minimal blood loss.

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DISCUSSION

Francis P. Twinem (New York, New York): There are four main methods of performing a prostatectomy. All are excellent and have good results if properly done, and I believe in using all four methods. Each patient should be carefully studied, and the urologist should then select the method best suited to the particular case.

The two chief advantages of retropubic prostatectomy are that the patient has a somewhat shorter hospital stay than with suprapubic or perineal prostatectomy and that the operator usually should be able to see all bleeding vessels well and to secure excellent hemostasis. Dr. Fernicola has properly emphasized the importance of displacing the fat and veins which lie over the prostatic capsule with great gentleness, so the operator does not cause venous bleeding deep under the symphysis where they may be hard to ligate. He did not employ blood transfusion in seventy consecutive cases of retropubic prostatectomy which would indicate that he had attained effective hemostasis.

In my opinion, it is probably better to replace this blood in elderly men who have a blood loss estimated at 300 to 400 cc. or more. Of course, blood transfusion should not be given unless it is definitely indicated, but in any case in which there has been considerable loss of blood, this loss should be replaced promptly. The patient will recover his strength sooner and there will be less likelihood of any serious cardiac complication.

In a series of ninety-two consecutive cases of retropubic prostatectomy performed by various urologists at the New York Hospital, there were two cases of excessive primary bleeding and two cases of secondary hemorrhage. One death occurred eleven days postoperatively due to pulmonary infarction.

In 100 consecutive cases of suprapubic prostatectomy performed by me, there was one case of secondary hemorrhage requiring cystotomy and also one case requiring evacuation of clots with the Ellik evacuator. Blood transfusions were employed in a moderate number of these patients. There was no mortality in this series of 100 patients.

Kenneth L. Day (Summit, New Jersey): I have been performing retropubic prostatectomies since 1947, and in my opinion, it is an excellent operative procedure. It is a good procedure to use on patients who are a poor risk for surgery, because the operator has control of the situation at all times. The sources of bleeding can be visualized with care and complete enucleation of the gland performed with visualization of the whole prostatic bed. Postoperatively the patients require a minimum amount of nursing care and are usually comfortable.

I agree with Dr. Twinem about blood transfusions. I often start them before the operation because I believe older patients suffer fewer complications if they are given blood. I do not look on blood transfusions as something to be avoided, but I do agree that the loss of blood in retropubic prostatectomy can be kept at a minimum without difficulty. I use interrupted sutures in the capsule instead of continuous sutures and suture ligatures on the periprostatic veins instead of coagulation. I also perform cystoscopy upon all of my patients prior to surgery.

Anthony R. Fernicola: I concur that blood transfusion is indicated for replacement of appreciable blood loss or as a supportive measure. However, an operative procedure of short duration with negligible blood loss ordinarily requires no blood transfusion except for particular conditions.

Retropubic prostatectomy can be performed within thirty to forty-five minutes. The return of bladder irrigating fluid on completion of the operation is usually clear and reflects the improbability of appreciable postoperative loss of blood. However, the performance of retropubic prostatectomy for the moderately large and large size adenoma has merit only if prompt and effective hemostasis and minimal operative and postoperative stress are accomplished.

CASE REPORTS

Monilia Albicans Fungemia Following Multiple Pelvic and Abdominal Procedures Successfully Treated with Amphotericin B

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MORE and more articles are appearing which deal with the increase in mycotic infections since the advent of antibiotic and steroid therapy [*1,2,4,5,10–12*]. This is a report on a patient in whom albicans fungemia developed following multiple pelvic and abdominal operations. She was treated with amphotericin B and had a complete recovery.

CASE REPORT

The patient (a thirty-nine year old, white, Para 0, gravida 0, female) was admitted to The Woman's Clinic of The New York Hospital for the second time on November 2, 1957 with an intraepithelial squamous cell carcinoma of the cervix proved by cone biopsy. Her past surgical history was significant and included an appendectomy in 1938, a partial left oophorectomy in 1943, and exploration of the pelvis in 1945 at which time a laparotomy pad was removed, and a dilatation and curettage and cone biopsy of the cervix in 1957.

On November 22, 1957, a total hysterectomy, left salpingo-oophorectomy, lysis of adhesions, cystotomy, dissection and severance of the left ureter with an end-to-end anastomosis were performed. There were multiple adhesions in the pelvis between the small bowel, omentum and the uterus and the left broad ligament. The left tube and ovary were involved in a hard, indurated mass which extended out into the obturator fossa and through which the left ureter coursed. It was necessary to dissect down along the left lateral wall of the pelvis to the levators in order to mobilize this mass. At the conclusion of the dissection the ureter could be traced into the mass from above and distally could be seen entering the bladder, but within this hard, firm tissue it could not be identified. The ureter was severed, the mass removed, and the ureter re-anastomosed over a soft latex T tube. The pathologic report revealed chronic cystic cervicitis with squamous metaplasia and no residual carcinoma, minimal adenomyosis, chronic follicular salpingitis, perisalpingitis, chronic lymphadenitis, and peripheral sclerosis of the ovary.

Because of the difficult operation, tetracycline, penicillin and streptomycin were given for the next seven to thirteen days, respectively. (Fig. 1.) One week following her original operation signs of intestinal obstruction developed and on December 4, 1957, a laparotomy was performed with lysis of multiple adhesions and release of a complete obstruction of the small bowel. The patient was maintained on intravenous fluids, tetracycline, constant intestinal suction, and minutely controlled intake and output as shown in detail in Figure 1. Despite this, she had a second obstruction of the small bowel and on December 14, 1957 had her third laparotomy within three weeks' time. It required six hours to release the many adhesions and sites of obstruction.

For the next week, this critically ill patient was given daily infusions, neomycin, erythromycin, chloramphenicol, hydrocortisone, and ACTH. On her sixth postoperative day there was evidence of an infection in the wound requiring incision and drainage down to the fascia. She was then given

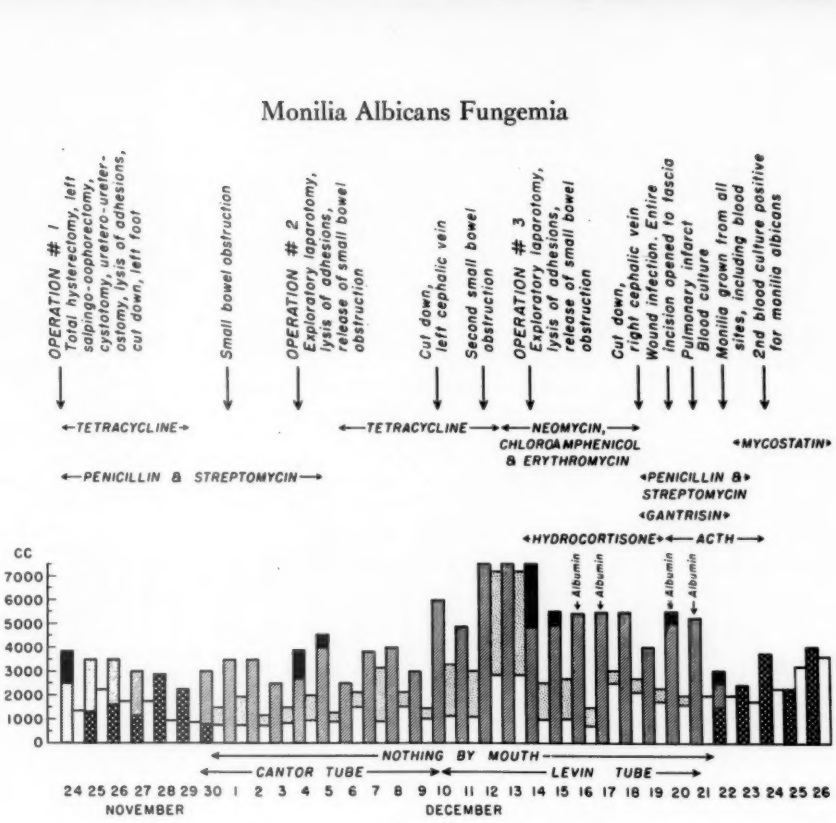

FIG. 1.

penicillin, streptomycin, and Gantrisin® for the next five days and therapy with the previously mentioned antibiotics was discontinued.

One week later, on December 21, 1957, the patient suddenly complained of severe chest pain, dyspnea, and profound weakness. She became cyanotic; tachypnea developed, and a clinical and roentgenologic diagnosis of a pulmonary infarct was made. Oxygen, digitoxin, and anticoagulant therapy was instituted immediately and during the next two weeks the subjective and objective signs of this pulmonary complication gradually subsided.

On December 22, 1957, the cultures from the bladder, vagina, intestines, intravenous catheter, ureterostomy catheter, abdominal wound, and blood were reported as positive for M. albicans. All the antibiotics were immediately stopped and Mycostatin® therapy, 200,000 units daily, was begun and continued for the next twenty days. On December 23, 1957, the Levin tube was removed and she began taking nourishment by mouth for the first time in twenty-four days. On December 24, 1957, a second blood culture was reported as positive for M. albicans.

On December 27, 1957, because of the demonstration of generalized moniliasis, the patient received 7 mg. of amphotericin B suspended in 150 cc. of 5 per cent glucose in distilled water over a six hour period. The following day she tolerated 15 mg. without incident, and the next day 55 mg. (1 mg./kg.). She continued on this daily intravenous dosage for the next thirty days. On December 31, 1957, the patient complained of blurred vision, unrelated to and persistent despite intravenous administration of amphotericin B. Examination revealed macular exudates in both eyes due to the M. albicans fungemia. (Fig. 2.)

During the next month the patient continued to improve. In the initial part of the drug therapy she experienced chills, fever, anorexia, and malaise, but as the therapy continued these symptoms of toxicity gradually subsided. The blood urea nitrogen averaged 26.4 mg. per cent, with a peak of 43 mg. per cent and a low of 19 mg. per cent, but with no evidence of azotemia. On January 21, 1958, sixty days following her original operation, the latex T tube was removed from the left ureter. An intravenous pyelogram showed good bilateral function with no evidence of a hydroureter or stricture. On January 26, 1958, the amphotericin was discontinued and for the first time in sixty-three days, the patient did not receive any intravenous fluids or therapy. Blood cultures were taken periodically as recorded in Figure 1 and were con-

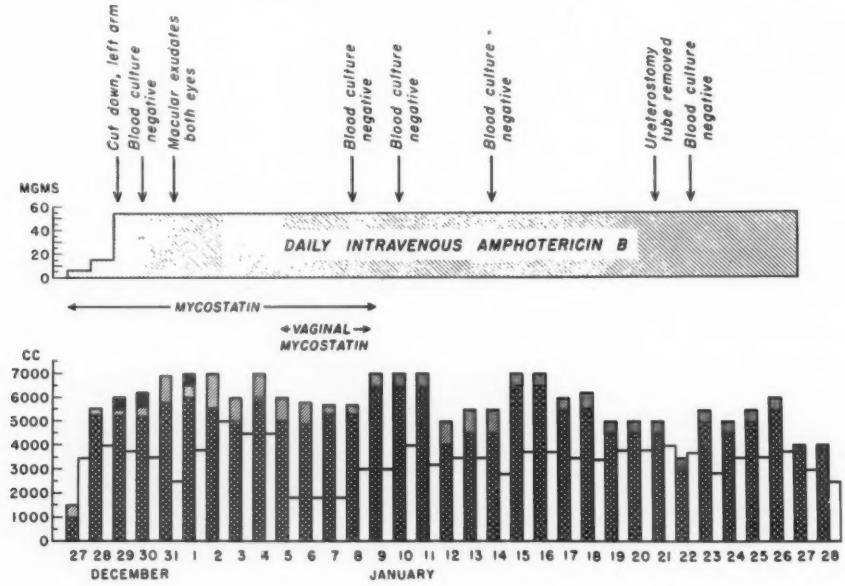

FIG. 2.

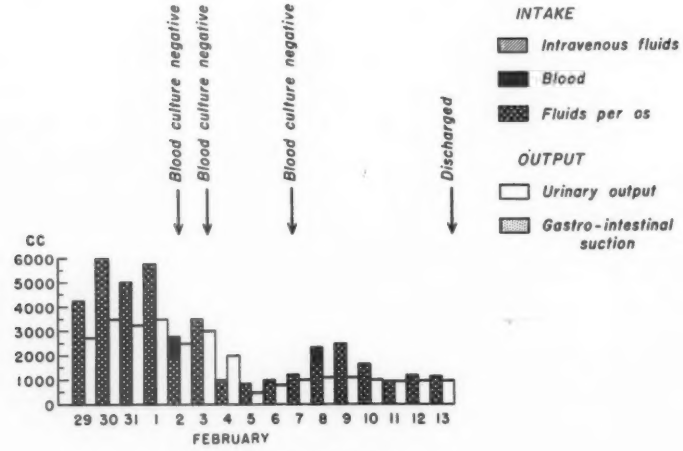

FIG. 3.

sistently negative for M. albicans. The patient was finally discharged from the hospital on February 13, 1958 on her eighty-fourth hospital day.

Subsequent Course. The patient's progress was followed closely for the next six months with a gradual but definite return to normal life. She had no return of intestinal complaints; the abdominal wound healed with healthy granulation tissue; her vision returned to normal; and an intravenous pyelogram on May 22, 1958 was completely normal. On August 25, 1958, however, she complained of increasing abdominal pain, and the awareness of an enlarging mass in the lower abdomen. She was admitted to the hospital for the third time where roentgenologic and pelvic examinations revealed a 15 cm. semi-fixed mass in the right side of the pelvis, filling the hollow of the sacrum, bulging into the top of the vaginal vault, and extending halfway to the umbilicus.

On September 17, 1958, the patient was subjected

to her seventh major abdominal procedure—the fourth within nine months' time. A right oophorcystectomy with removal of a serous cyst measuring 10 by 16 cm. was performed. Her postoperative course was uneventful and she was discharged on her eighth postoperative day. (Fig. 3.)

On October 20, 1958 she complained of painful keloid formation in her incision and this was treated with 1,500 r. low voltage radiation, with excellent resolution.

On May 21, 1960 she was again admitted to The New York Hospital with abdominal pains, nausea and vomiting. Roentgenograms revealed evidence of a partial small bowel obstruction. This was relieved, however, by means of constant intestinal suction and intravenous fluids. Cultures of the blood and bowel content were negative for M. albicans. The patient was discharged on June 22, 1960 and has had no further episodes of abdominal pain. Her most recent visit was on July 1, 1960.

COMMENTS

Amphotericin B, an antifungal antimicrobial agent extracted from cultures of a South American strain of streptomyces, has recently been employed in the treatment of many types of mycotic infections [3,4,7–9]. Most of these reports deal with patients in generally poor medical condition, or, as in the present case, following prolonged surgical procedures.

We have had experience with three other cases of monilia fungemia during the past three years. Two of these patients had rheumatic heart disease and developed monilial endocarditis. These patients were treated with amphotericin B but were never cured permanently of their blood stream infection and eventually died. In the subject of this case report, there was a period of time in the earliest stages of the disease when a harsh murmur and thrill appeared. We can only speculate that this represented an acute endocarditis or valvulitis which subsequently was cured or regressed. The third patient is the most recent case and, like the patient reported here, had no detectable cardiac defect and has responded to treatment. However, this patient's treatment has only been discontinued for one month.

From a close study, it is apparent that under normal conditions, M. albicans is a relatively low grade pathogen, but in the setting of massive antibiotic or steroid therapy, the virulence of this fungus is greatly enhanced. This fact has also been demonstrated in the laboratory [13,14]. In the past, once this infection was established in the vascular system, it was always fatal. In the case reported, we believe the long-standing intravenous polyethylene catheter was the nidus of infection from which the organism was seeded. One might ask if removal of the catheter might result in a spontaneous cure since the infecting organism is such a low grade pathogen. In our most recent experience, this was done. There was a dramatic drop in the temperature and the patient was subjectively well for three days. After this, symptoms reappeared and the blood cultures were again positive for M. albicans. Treatment with amphotericin B was then begun and the blood cultures became negative.

It should be noted that the subject of this case report was receiving oral Mycostatin during the same period of time she was being given the amphotericin B. Since Mycostatin is not absorbed from the gastrointestinal tract, it seems reasonable to assume that this drug was not responsible for the irradication of the widespread monilia infection.

SUMMARY

A case of M. albicans fungemia following multiple celiotomies treated with amphotericin B with complete recovery is presented. Other cases with M. albicans fungemia have been reported, but as far as we have been able to determine, the present patient is the only reported survival.

Acknowledgment: We wish to thank Miss Elizabeth Broedel for her work in the preparation of the illustrations included in this paper.

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Epidermoid Cyst of the Spleen

REPORT OF TWO CASES

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CYSTS of the spleen are rare lesions. Fowler [3] reported a total of 265 splenic cysts of all varieties in his collective review (to May 1952). The first reported case of epidermoid cyst of the spleen is credited to Shawan [9] in 1933.

The purpose of this paper is to present two additional cases of epidermoid cyst of the spleen with a current review of the literature.

Fowler's classification [3] of benign non-parasitic cysts of the spleen is as follows:

I. Primary with cellular lining; component endothelium
   - A. Congenital
   - B. Traumatic
   - C. Inflammatory
     1. Infoliation cysts
     2. Dilatation cysts; lymphangiectatic, polycystic disease
   - D. Neoplastic cysts (also congenital)
     1. Epidermoid } non-component epi-
     2. Dermoid } thelium
     3. Lymphangioma
     4. Benign, cavernous and capillary hemangioma

II. Secondary, no cellular lining.
   - A. Traumatic (blood and serous types)
   - B. Degenerative (liquefaction)
   - C. Inflammatory (necrosis, tuberculosis)

CASE REPORTS

CASE 1. A seventeen year old white girl was admitted to the Deaconess Hospital, Oklahoma City on June 17, 1958, with acute abdominal pain of about fourteen hours' duration. During the evening prior to admission a sudden onset of generalized abdominal pain occurred which radiated into both shoulders. The pain was so severe that the patient fainted. The pain persisted during the night and she vomited several times.

Her previous history was non-contributory except for a voluntary reducing diet to decrease the size of her abdomen which she thought was larger than usual during the previous few months.

On admission physical examination revealed an acutely ill, young white female. Blood pressure was 110/60 mm. Hg and pulse was 88 beats per minute. She was alert and cooperative and the skin was warm and dry. There was generalized abdominal rigidity with guarding and rebound tenderness throughout the lower part of the abdomen. Rectal examination revealed increased tenderness on the right side.

On admission laboratory data were as follows: hematocrit was 33 per cent and total white blood cell count was 11,400 per cu. mm. Urinalysis revealed numerous white blood cells, a 3 plus sugar reaction, but no acetone. The latter was attributed to collecting the specimen following the administration of glucose intravenously.

The patient underwent exploration one and a half hours after admission. The abdomen was opened through a right paramedian incision. On opening the peritoneum a large amount of blood was encountered and there was a mass that filled the left mid-abdominal cavity. (Fig. 1.) This mass grossly resembled a large subcapsular hematoma of the lower half of the spleen. The incision was extended upwards, and a rent was noted in the lateral aspect of the mass with active bleeding. Splenectomy was performed; the spleen contained a bluish gray cystic mass measuring 20 by 15 cm. This mass could not be separated from the spleen. Its central portion contained dark clotted blood.

During and immediately following surgery 2,500 cc. of whole blood was given with one brief period of clinical shock occurring four hours postoperatively. On the third postoperative day hematocrit was 37 per cent and hemoglobin was 11.6 gm. per cent. Urinalysis one week postoperatively was within normal limits. Increased platelets were noted on the third postoperative day. A total count was not performed.

Pathologic report revealed that the spleen was approximately 17 cm. long and contained a cyst

FIG. 1. CASE I. Photograph of spleen showing the large unilocular cyst completely replacing the lower pole.

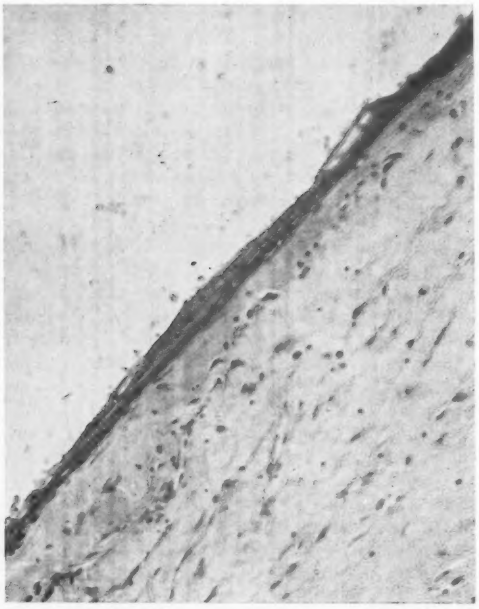

FIG. 3. CASE I. Photomicrograph of cyst wall demonstrating the stratified squamous epithelium lining overlying the densely hyalinized connective tissue.

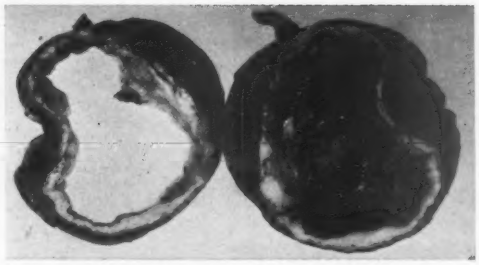

FIG. 2. CASE I. Photograph of a cross section of splenic cyst demonstrating the thickened gray lining with narrow rim of compressed pulp surrounding it.

measuring 10 cm. in its greatest diameter. The cyst was lined by wrinkled, gray and glistening tissue. (Fig. 2.) Surrounding this there was a narrow rim of soft, purple tissue. Microscopic examination revealed a central cystic space lined by stratified squamous epithelium resting on densely hyalinized connective tissue. (Fig. 3.) Beneath this there was a narrow zone of compressed splenic substance showing some evidence of congestion and hemosiderin deposition. Impression was a benign epidermoid cyst of the spleen.

CASE II. A fifty year old white female housewife was admitted to the Parkview Hospital, El Reno, Oklahoma, on March 5, 1958. She complained of pain in the left upper part of the abdomen and left shoulder. This pain was noted first about two months prior to admission, initially only on lying down but later also with deep breathing. It was not related to exertion or eating and there was no specific history of trauma. A physical examination one month prior to admission was within normal limits.

Physical examination on admission to the hospital revealed no abnormalities except for a mild vaginitis. Following the x-ray study which will be described, a questionable mass was palpated high in the left upper part of the abdomen.

Laboratory data revealed that the hemoglobin was 13 gm. per cent and hematocrit was 40 per cent. The total white blood cell count was 7,350 per cu. mm. with a normal differential. Urinalysis was within normal limits.

An upper gastrointestinal series, barium enema and intravenous pyelogram revealed no intrinsic disease but each demonstrated extrinsic displacement due to a soft tissue mass in the left upper part of the abdomen. (Figs. 4 and 5.)

On March 14, 1958, through a left subcostal abdominal incision, a cystic mass was encountered in the left upper part of the abdomen extending downward to the costal margin. The cyst was attached to the spleen and had a slightly blue color. Splenectomy was performed. A solitary cyst

FIG. 4. CASE II. Roentgenogram demonstrating downward and medial displacement of the barium-filled stomach by the splenic cyst.

FIG. 5. CASE II. Roentgenogram demonstrating the downward displacement and rotation of the left kidney on intravenous pyelography by the soft tissue mass (splenic cyst).

measuring about 15 cm. in diameter containing straw-colored fluid was removed intact with the spleen.

Postoperatively the patient had an uneventful convalescence and on March 21, 1958, hemoglobin was 11.3 gm. per cent and hematocrit 39 per cent.

Pathologic report was as follows: The specimen weighed 134 gm. and measured 12 cm. in its long axis. In its mid-portion there was a cyst wall. This was formed in part by firm, gray tissue and in other areas the lining appeared to be formed by trabeculated, white tissue. The surrounding spleen appeared grossly normal. Microscopic sections of the cyst wall revealed a lining of dense hyalinized connective tissue with numerous superimposed areas of normal appearing stratified squamous epithelium. (Fig. 6.) The underlying stroma was fibrous. There were no secondary skin appendages. Impression was a benign epidermoid cyst of the spleen.

REVIEW OF THE LITERATURE

The first reported case of cyst of the spleen is credited to Andral in 1829 [1]. It is also one of the few dermoid cysts of the spleen ever reported. Martin, Zegea and Adamson [5] collected reports of 183 non-parasitic splenic cysts in 1950. However, probably the most exhaus-

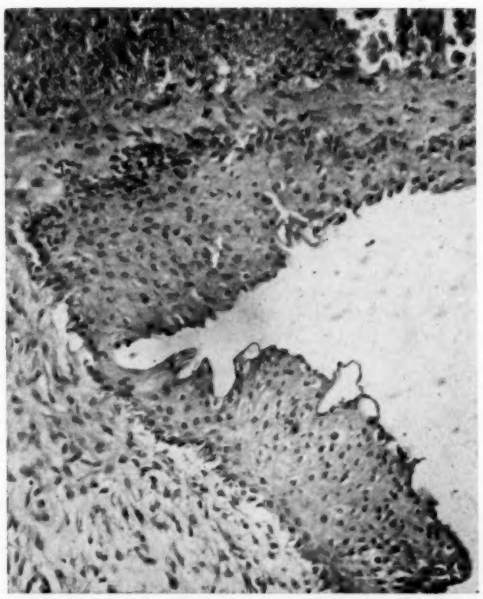

FIG. 6. CASE II. Photomicrograph of the cyst wall demonstrating the stratified squamous epithelium lining along with underlying splenic pulp.

TABLE 1

THIRTY-ONE REPORTED CASES OF EPIDERMOID CYSTS OF THE SPLEEN

Author	Age (yr.), Sex	Remarks
Pohle*	19, F	Splenectomy with recovery
Schneider	14, M	Splenectomy with recovery
Shawan*	16, F	Splenectomy and recovery, history of trauma
Santy*	15, M	Splenectomy with recovery
Dinand†	16, M	Splenectomy with recovery
Montgomery, McEnery and Frank	7, F 6 mo., M	Mass of the left upper part of the abdomen, splenectomy History of trauma, died
Harding	22, F	Abdominal swelling for 7 yr.
Weil, Rouxberger and Scemama	15, F	History of trauma, splenectomy and recovery
Bergan†	25, M	Splenectomy and recovery§
Lereboullet, Gregoire, Bernard and Ibarran	8, M	Splenectomy with recovery
Parker and Brown†	16, F	Large painless mass, splenectomy with recovery
Bostick and Lucia†	20, M	Splenectomy with recovery
Paul†	19, F	Painful mass in abdomen, splenectomy with recovery
Gosset, Betrand and Gosset†	16, F	Mass 9 mo. following injury, splenectomy and recovery
Jameson and Smith†	18, M	Splenectomy with recovery
Lang, Morton, Steele and Schaeffer†	39, F	Transthoracic rupture, splenectomy with recovery
Custer	.....	Not clinically reported
Lahey Clinic†	8, M	Splenectomy with recovery
Carnett, Bates and Linney†	11, F	Splenectomy with recovery
Radakovich†	17, F	Abdominal mass, splenectomy and recovery
Elias and Linn†	22, M	Splenectomy with recovery
Bostick†	14, F	Splenectomy with recovery
Parnes‡	22, F	Pain in the upper part of the abdomen for 4 mo., died
Pautrat et al.‡	21, M	Swelling upper part of the abdomen, splenectomy and recovery
Bean and Stahlgren‡	21, F	Abdominal mass for 7 mo., history of trauma, splenectomy, recovery
Soutter and Castleman‡	11, M	Fever 3 wk. after football injury, splenectomy and recovery
Lee and Arnspiger‡	33, F	Mass on the left side of the abdomen, splenectomy with recovery
Posner	8, F	History of trauma preceeding mass, splenectomy with recovery
Coleman	17, F	Rupture with intraperitoneal hemorrhage, splenectomy with recovery
	50, F	Mass on roentgenogram, splenectomy and recovery

* Cases cited by Shawan [9].
† Cases cited by Fowler [3].
‡ Cases cited by Lee and Arnspiger [4].
§ There is some doubt that Bergan's case is that of an epidermoid cyst. According to the description given it may be a serous cyst.

tive review of non-parasitic splenic cysts is that of Fowler [3] who collected 265 cases in 1953.

In his report Fowler [3] lists a total of twenty-three epidermoid cysts including the four originally reported by Shawan [9]. Radakovich [8] reviewed all cases of epidermoid splenic cysts in the literature until 1950 and added one personal case. Arnspiger and Lee [4] in 1958 collected four cases of epidermoid cysts reported since Fowler's summary of 1953 and added one personal case. Table 1 is a composite of all known cases of epidermoid cysts of the spleen including the two additional personal cases described herein.

COMMENTS

Compared with the frequency of cysts in other abdominal organs, cysts of the spleen are rare. The secondary type of non-parasitic cyst is the most common and comprises about 60 per cent of the total [3].

It is not a primary purpose of this paper to

discuss the origin of splenic cysts; however, this is one of their most intriguing aspects. The theories regarding this have been reviewed in detail by several authors [3,6,8,9]. One notes frequently a history of trauma, even in the true or primary cysts. Martin and associates [5] have explored the vascular theory in their animal experiments.

Another frequent observation is the fact that the true nature of any splenic cyst cannot be established grossly and the microscopic diagnosis is not complete without multiple and often repeated sections from different areas of the specimen. Shawan [9] established the diagnosis of a primary (epidermoid) cyst only after making further sections on a "pseudocyst" removed nine years earlier.

It is also noted that the epithelial or endothelial lining may be present in multiple and sometimes isolated areas. In the case reported by Posner [7] the lining epithelium of the solitary cyst varied from a rather typical low cuboidal single cell layer to stratified squamous epithelium ranging up to six cell thicknesses with intercellular bridges. The clinical history in Posner's case again demonstrates the rapidity of growth possible even in the true cysts and presents trauma as a common etiologic agent. This patient was an eight year old girl, in whom a cyst developed measuring 8 inches in diameter in the two-week period following the onset of abdominal symptoms and six weeks following a definite history of trauma. This rapid growth has also been noted in serous cysts [2].

Splenectomy is the treatment of choice for benign splenic cysts. Intra-abdominal hemorrhage in conjunction with an epidermoid cyst, described in Case 1, is a rather unusual complication.

SUMMARY

Two cases of epidermoid cysts of the spleen are presented with a review of the current literature. This brings the total number of reported cases to thirty-one.

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Ainhum (Dactylolysis Spontanea)

REVIEW OF THE LITERATURE AND REPORT OF A CASE

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NORTON, Sala, and Silverstein [*56*] of New York Medical College, Metropolitan Medical Center, reported a case of ainhum in 1956. It was the first noted to have afflicted a Puerto Rican man in the United States. Because of the rarity of this disease in the United States we are now reporting another case of ainhum which developed in a Puerto Rican woman bilaterally. The sex and extent of the disease in the present case report make it even more interesting. The historical and etiological background will be discussed.

Ainhum, a relatively rare disease of unknown etiology, was first reported by Clark in 1860 among natives of the African Gold Coast and described by him as a "dry gangrene of the little toe" [*16*]. In 1867, da Silva Lima together with Wucherer introduced the term "ainhum" [*20*]. According to the Reverend J. T. Rowens [*60*], ainhum is a term from the Yoruba language meaning to "saw" or "file." Matas, however, believed that the term was derived from the Brazilian Negro Patois, meaning "fissure" [*52,53*].

At the Fourth Annual Meeting of the American Dermatological Association in 1880, da Silva Lima [*19*] reported a decrease in the number of cases of ainhum in Brazil which was apparently due to new laws abolishing the importation of African slaves into Brazil.

GEOGRAPHIC DISTRIBUTION

Numerous reports have come from Brazil [*19–21*], Panama [*43,46,79,80*], east and west Africa [*5,16,22*], the West Indies [*23,32,57*], and India [*17,18,28,76*]. Crawford [*17*] noted that, in India, one out of every 2,500 patients hospitalized on a surgical service had ainhum. Although most cases involve Negroes and Indian Hindus, documented reports of white persons with the disease are noted [*7,42,62*]. Sporadic case reports have come from Canada [*4*], Egypt [*55*], British Guiana [*75*], and Europe [*7,27*].

The first case of ainhum reported in the United States was in 1881 when Hornaday recorded this occurring in a ten year old Negro girl living in North Carolina [*38*]. In this country it has been found most frequently in Negroes living in the South [*3,8,9,29,90*], particularly in the Gulf States [*37,41,44,51–53*], the Carolinas [*25,38,54*], Virginia [*24,66*] and the District of Columbia [*1,59*]. However, cases are recorded in Illinois [*35,36,73*], Pennsylvania [*31*], New York [*11,39,56*] and New Jersey [*68*].

According to Martens and Norris [*50*], over 200 cases were reported in the world literature up to 1944, the United States representing about twenty-five per cent of the total. In 1956, Norton, Sala, and Silverstein [*56*] found a total of 102 cases reported from the United States to which they added their case.

ETIOLOGY

The specific cause is not known. Historically, there were theories that it was a form of leprosy. This was disproved in 1872 by Wucherer [*89*] and other early investigators [*6,19,20*]. At the International Leprosy Conference in Berlin in 1897, Zambaco [*91*] renewed interest in the leprosy theory. Heitzmann [*34*] incriminated self-mutilation, i. e., the practice of placing rings and ligatures about the digits. Grschebin [*33*] and da Silva Lima [*19,20*] believed the disease was a circumscribed scleroderma. Shepherd [*63,64*] and Scheube [*61*] believed ainhum to be due to a trophoneurosis. In 1896 Matas [*52,53*] wrote that the disease was actually an annular scleroderma due to a trophoneurosis. Weinstein

[79,80], Pusey [58], Abbe [1], and Welch [81] shared somewhat similar views with Matas.

A traumatic theory was shared by Eyles [26], Manson-Behr [47,48] and Maass [45]. Wellman [86] believed that the disease was essentially infectious and that the chigger, Sarcopsylla penetrans, was the responsible agent. Horwitz [40] reported a case in 1887, believing bacterial infection to be the cause. Castellani [13,14] maintained that parasitic infestation was basically responsible. In 1924 Wright [88] reported a case in a patient with syphilis and speculated upon its relationship to lues. Acton (1928) believed the disease to be a "band scleroderma" due to hypothyroidism and parathyroid dysfunction [2].

CLINICAL MANIFESTATIONS

A circular furrow, the so-called "constricting band," gradually but progressively encircles the digit from the digitoplantar fold. With progression of the constricting furrow the distal part of the toe becomes bulbous and enlarged, remaining attached to the foot by only a narrow pedicle in late cases. The final stage is spontaneous amputation.

The fifth toe is most commonly affected [15,41]. Occasionally other toes of the foot are involved [19]. Castellani [13] states that 10 per cent of patients show involvement of the fourth toe. Cases of bilateral involvement are reported [13,14,30,43,49,69,71,73]. Males are affected more often than females in a ratio of about 2:1, with a peak incidence in the third and fourth decades [15,59,67]. The duration of the disease is not constant, that is, from the first notation of the furrow until spontaneous amputation occurs or surgical amputation is performed. The shortest duration reported was probably Gessner's case [30], in which spontaneous amputation took place after one month.

Weinstein states that the duration may be as long as twenty years [79,80]. However, in more than 50 per cent of the cases the duration is less than five years [67]. Pain is described by the large majority of patients but is usually late in the disease and due to secondary ulceration.

Ainhum has been seen in several members of the same family [19,20,23,24,61,65,78,79,80,87]. Maass reported that half his cases had a familial history [45].

Ainhum is not associated with any constitutional symptoms. The differential diagnosis between leprosy, scleroderma, Raynaud's disease, congenital constrictions of the digits and neurotrophic ulcers should not present any real problem.

PATHOLOGY

A variable microscopic pattern is seen, depending upon the stage of the disease. The first pathologic review was by Wucherer [89]. Histopathologic investigation by Weber [78] in 1868 stimulated interest in this entity. Detailed descriptions were subsequently recorded by Herrick [35,36], von Schüppel [74], Duhring [24], Weinstein [79,80] and Heitzmann [34]. Hyperkeratosis of the epidermis is noted especially in the region of the furrow. (Figs. 3A and B.) The papillae are somewhat elongated. A chronic inflammatory reaction is seen in the corium with connective tissue proliferation, round cell infiltration and edema. The sweat glands are atrophied. No lymphatic changes are seen but the blood vessels may show varied pathologic changes. These range from no change at all to complete occlusion of the end arteries with intimal destruction. This vascular pathology is always secondary. Burch and Hale [12] reported a case in which plethysmographic studies of the digital circulation were performed. They found no evidence of an inadequate blood supply to the digit. Microscopic sections of the bone may show rarefying osteitis with connective tissue replacement but the degree will vary with the duration of the disease and the area of bone sectioned.

ROENTGENOLOGIC FINDINGS

The osseous changes are variable as described. In early cases narrowing of the trabeculae with bone absorption in the digit adjacent to the furrow is seen. As the disease progresses the bone resorption becomes complete proximal and sub-adjacent to the furrow. The distal phalanx may be preserved but often is involved in the rarefying osteitis [7,27,41,67].

PROGNOSIS AND TREATMENT

When the disease is recognized, even before pain is a prominent symptom, amputation of the digit should be performed since pain will sooner or later become manifest. This is true in the large majority of cases, particularly when secondary ulceration occurs. Early amputation will therefore avoid this painful stage.

FIG. 1. The furrow is seen encircling the left fifth toe. The right fifth toe is missing, having been previously amputated for ainhum.

FIG. 2. Surgical specimen. Areas of secondary ulceration are seen adjacent to the furrow.

Bloodless, spontaneous amputation is the end result in cases which are not treated surgically.

The procedure of incising the furrow parallel with the long axis of the toe with the intent to relieve the constrictive action of the lesion has been abandoned due to uniformly poor results [27].

CASE REPORT

E. L. (No. 1298-33), a thirty-five year old Puerto Rican woman, was admitted to the surgical service of Metropolitan Hospital on May 14, 1959 complaining of pain in the small toe of her left foot.

Present Illness. The patient noted pain for the first time six months prior to admission. About two years before the onset of the pain she became aware of a "deformity" of the toe.

Past History. She stated that the small toe of her right foot was amputated in Puerto Rico in 1949 (ten years prior to this admission). A similar "deformity" of this toe was noted three years before the onset of pain. In 1957 she was treated for syphilis with penicillin.

Family History. In the latter part of 1949, following the amputation in Puerto Rico, the patient came to the United States to live. This was the first time she had ever left her country. Her parents, brothers, sisters and children were never afflicted with ainhum.

Physical Examination. The patient was a well nourished, well developed, dark skinned Puerto Rican woman complaining of pain in the small toe of the left foot. Ambulation was particularly painful. The characteristic furrow or "constricting band" was present about the toe. (Fig. 1.) There were also areas of ulceration adjacent to the furrow.

FIG. 3A. Photomicrograph showing hyperkeratosis of the epidermis. This section is through the area of the furrow.

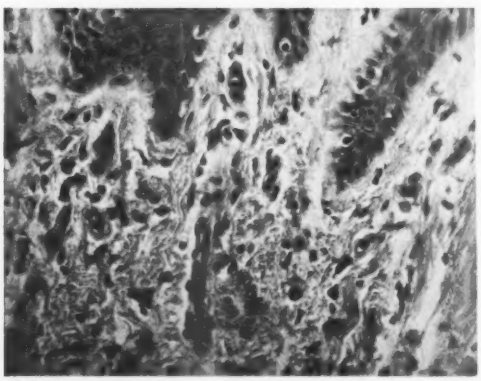

FIG. 3B. Photomicrograph of a section sub-adjacent to the furrow. The dermal layer shows a moderate amount of fibrous connective tissue with round cell infiltration. In the upper half of the photograph elongated papillae are seen.

FIG. 4. Roentgenograms of both feet. The right foot reveals amputation of the fifth toe at the level of the metatarsal neck. The left fifth toe shows bone absorption of the proximal phalanx and narrowing of the trabeculae.

(Fig. 2.) Excessive mobility of the digit distal to the furrow was not present. Palpation of the toe caused pain and passive motion was exquisitely painful. There was no discoloration or coldness to indicate impaired circulation. Bilateral varicosities of the greater saphenous system were observed with valvular incompetency. All peripheral pulses were intact. Oscillometric readings were within normal limits. The small toe of the right foot was missing, with a healed scar over the metatarsal head. The remainder of the physical examination was within normal limits.

Laboratory Data and Roentgenographic Studies. The serologic test for syphilis was positive. Roentgenograms of the feet revealed absorption of the bones of the left fifth toe, particularly the proximal phalanx in its distal and middle third. There was roentgenologic evidence of amputation of the right fifth toe at the level of the metatarsal neck. (Fig. 4.) Other laboratory studies, which included roentgenograms of the chest, complete blood count, blood urea nitrogen, fasting blood sugar, electrocardiogram, urinalysis and nasal smears for Mycobacterium leprae were negative.

Hospital Course. On May 26, 1959, the left fifth toe was amputated through the metatarsophalangeal joint under general anesthesia. One week later the patient was discharged, asymptomatic, to the Out Patient Clinic for follow-up care.

SUMMARY

The second case of ainhum from Metropolitan Medical Center has been described. Both cases are the only known reports in the American literature of Puerto Ricans afflicted with ainhum. The unusual nature of the present case is noted, in that the patient was a woman with bilateral involvement. The literature has been reviewed.

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Extracranial Meningioma Presenting as a Tumor of the Neck

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THE differential diagnosis of tumors in the region of the retromandibular space is usually dictated by the known subjacent tissues. Thus, benign and malignant parotid tumors, carotid body tumors and neoplastic growths of lymph nodes, muscles, nerves, adipose tissue, or bone are usually considered. The rarity of extracranial meningiomas, especially occurring in this area, prompted the following case report and review of the literature.

CASE REPORT

This twenty-two year old male patient (U-21589) was first admitted to the Veterans Administration Hospital on December 16, 1957, because of a slowly enlarging tumor mass at the angle of the left jaw. Past history disclosed that this had been enlarging over the preceding four years. No symptoms were referable to it. Ten months previous to admission, biopsy had been reported as "scarred parotid tissue with many calcifers." Initial clinical impression was a mixed tumor of the parotid gland with a possibility of carcinomatous change.

Physical examination showed a firm, 3 inch, rounded mass posterior and inferior to the left ascending ramus of the mandible. (Fig. 1A.) Intraoral examination showed the left lateral pharyngeal wall was displaced medially, but without invasion of overlying tissues which were freely movable. Neurologic examination showed normal function of the cranial nerves through the ninth nerve.

The tenth, eleventh and twelfth cranial nerves were involved, causing fixation of the left vocal cord, atrophy of the left sternocleidomastoid muscle, weakness of the left trapezius (attributed by the patient and family as secondary to undiagnosed polio in the past), and deviation of the tongue toward the left. Neurologic examination otherwise was completely within normal limits.

X-ray films showed a slight increase of bony density in the posterior cranial fossa and asymmetry of the left ascending ramus of the mandible from a soft tissue mass lying posterior and medial to it. No bony destruction was seen and no calcification was noted in the mass.

Review of the previous biopsy sections raised a strong possibility of meningioma, and preoperative evaluation was focused on intracranial origin or components. Lumbar puncture and electroencephalogram revealed no abnormalities. Audiometric and vestibular function tests were within normal limits. Carotid arteriograms showed no intracranial distortion. Cut-down carotid compression and intra-arterial sodium amytal showed adequate collateral circulation if it should be necessary to sacrifice one internal carotid artery during operation.

On March 12, 1958, with the patient under hypothermic, hypotensive anesthesia, the tumor was exposed through a left cervicofacial incision. (Fig. 1B.) Grossly, the tumor was encapsulated, firm, white, whorled tissue which incorporated the vagus and hypoglossal nerves in conical projections. The internal jugular vein was atrophied to a fibrous cord. The external carotid artery was sacrificed to allow removal of the tumor mass, which had to be morcellated because of its size. It was firmly adherent to the base of the skull in the vicinity of the jugular and carotid foramina and the foramen lacerum, and to the internal carotid artery. Although it was realized that there might be extension into the wall of the carotid artery and into the foramina, the bifossal approach necessary for intracranial exploration was considered a contraindication to further surgery at this time.

The wound healed *per primum* and the postoperative course was uneventful. When last seen, one year postoperatively, the patient was well and asymptomatic.

1A 1B

FIG. 1. A, preoperative appearance showing location of retromandibular meningioma and previous biopsy site. B, postoperative appearance showing cervicofacial incision used for exposure.

FIG. 2. Gross appearance of tumor showing a whitish, homogenous appearance.

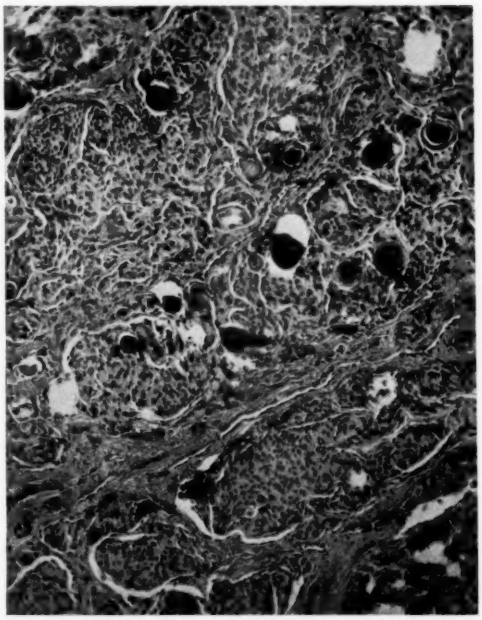

FIG. 3. Photomicrograph showing concentrically laminated calcifications in the center of whorls of spindle-shaped cells.

Pathologically, the main tumor mass consisted of firm homogenous gray-white tissue measuring 7 by 5.75 by 5 cm. (Fig. 2.) Histologically it consisted of sheets and whorls of uniform spindle-shaped cells with rare to no mitotic figures. There were many small concentrically laminated calcifications in the center of the whorls (Fig. 3), the remainder consisting of dense collagenous tissue.

COMMENTS

The similarity of the cellular structure of intracranial meningiomas to cell clusters capping the arachnoid villi and the cell nests included in the dura mater noted by Schmidt [*14*] in 1902 was the first important step in the understanding of these tumors. Aoyagi and

Kyuno [1] demonstrated in 1912 that the arachnoid cell clusters had predilection for certain sites, and are among others present at the point of penetration of the dura mater by the third, seventh, ninth, tenth, eleventh and twelfth cranial nerves. Cushing [6] in 1922 classified his clinical series according to sites of origin, showing seven cases arising from cranial nerve foramina, five from the trigeminal nerve sheath, and one each from optic and acoustic nerve sheaths. He further stated that, "these cases may be capable of greater subdivision since the cell clusters from which they arise are said to exist at the foramina of exit of all the nerves."

The case reported herein had several possible etiologic sites on the basis of foramina (carotid, jugular and lacerum) and cranial nerves (ten, eleven and twelve) involved. The most likely site is probably the vicinity of the jugular foramen at the egress of the vagus and spinal accessory nerves, explaining the subsequent obliteration of the internal jugular vein. The operative appearance of the vagus nerve leaving the lower pole of the tumor mass in a conical extrusion further strengthens this supposition.

In reviewing the literature on this subject, it is evident that the occurrence or growth of meningiomas outside of the cranial cavity or spinal canal is exceedingly rare. The case reports can be subdivided into the following four main groupings:

(1) Primarily intracranial tumors with extracranial direct extension: Procter and Lindsay [13] in discussing the destruction of the temporal bone by meningiomas cite a case in which ear symptoms had been present for nine years and at the time of admission, the patient had obliteration of the right jugular vein, destruction of the eleventh and twelfth cranial nerves at their exit through the skull, extension of tumor into the carotid canal and invasion or erosion of the tympanic cavity. They also cite three cases from the German literature by Grasser in 1910 of meningioma of the temporal bone, in two of which facial paralysis and deafness were present, and in one of which the tumor had extended through the jugular foramin into the neck where it was palpated preoperatively.

Erosion through the cribiform plate [3], orbital cavity, or skull [9] may occur, and New and Devine [11] reported three cases involving the frontal sinus.

(2) Originating from arachnoid cell rests of cranial nerve sheaths with extracranial growth: Craig and Gogela [10] reported seventeen cases of primary intraorbital meningioma, and there have been other isolated case reports of tumors arising from the optic nerve sheath. Cushing's series listed five tumors arising from the trigeminal nerve, but none with extracranial growth. Therefore, no cases have been reported of extracranial growth probably originating from cranial nerve sheaths, other than the optic. The gross anatomy of the case reported herein would lead one to assume that the site of origin was the vicinity of the jugular foramen, possibly the vagus or spinal accessory nerve sheath.

(3) Extracranial growth without any apparent connection with foramina or cranial nerves presumably from embryonic rests of arachnoid cells: Zachariae [17] reported a subgaleal meningioma over the left temporal area without invasion of bone, and Conley [5] described the surgical removal of an infratemporal meningioma invading the lateral orbital wall, but not arising from the optic nerve. Shaheen [15] reported a psammoma of the maxillary antrum in a twelve year old boy without any neurologic symptoms or intracranial connections. Pendergrass and Hope [12] reported a case of meningioma arising on the outer table of the frontal bone which had no intracranial origin or extension. Bain and Shnitka [2] reported a case of cutaneous meningioma and cited six other cases from the European literature.

(4) Benign appearing intracranial meningioma with extracranial metastases: Verified metastases from apparently benign intracranial meningiomas have been reported in cervical [8] and mediastinal lymph nodes [16], liver [7] and lung [4,8].

SUMMARY

1. A case is reported of extracranial meningioma without any evidence of intracranial component presenting as a tumor of the neck or parotid region. Origin of growth was presumably from the vicinity of the jugular foramen and possibly from the dural sheaths of the vagus or spinal accessory nerves.

2. The literature on extracranial meningiomas, both primary and secondary, is reviewed. The rarity of origin from cranial nerve sheaths, other than optic, is pointed out.

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Massive Pulmonary Hemorrhage

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A twenty-five year old white housewife was asymptomatic until nine months prior to admission when dull aching pain in the left side of her chest, hemoptysis and weakness developed lasting seven days. The patient consulted a physician and was treated with "white tablets" without relief of pain. Roentgenograms of the chest or investigation of the origin of hemoptysis had not been undertaken. Three months later she was hospitalized in a mental institution because of a nervous breakdown after her husband was confined to prison. There, she had two convulsive seizures which were successfully controlled with Dilantin® and a diagnosis of chronic brain syndrome was made. At this time she experienced a second episode of hemoptysis which ceased spontaneously. A roentgenogram of the chest demonstrated active parenchymal pulmonary disease in the left upper lung field. She was transferred to a tuberculosis sanitarium and treated with streptomycin and isoniazid. Sputum cultures were consistently negative for acid fast bacilli. A bronchogram was obtained and demonstrated atelectasis due to obstruction of the apical posterior segment of the left upper lobe bronchus. The patient denied dyspnea, productive cough, pneumonitis, syncope or weight loss. She was transferred to the Ohio Tuberculosis Hospital for further diagnosis and treatment.

PHYSICAL EXAMINATION

This white woman was well developed and well nourished with normal vital signs. Fine, diffuse rales were heard over both lungs, loudest over the left upper lung field anteriorly. The heart was normal and the remainder of the physical examination was within normal limits.

LABORATORY DATA

Hemoglobin was 13.4 gm. per cent, hematocrit 41 per cent, white blood count 4,050 per cu. mm. with a normal differential. A catheterized urine specimen showed a specific gravity of 1.015 with many white blood cells per high power field. Blood chemistries were normal. Serology was negative. Sputum examinations for acid fast bacilli were negative by smear and culture. A purified protein derivative (PPD No. 1) skin test for tuberculosis was negative and intermediate PPD and No. 2 were positive. The histoplasmosis skin test was positive. Coccidioidomycosis and blastomycosis skin tests were negative. Histoplasmosis serology and colloidal agglutination tests were negative. Lumbar puncture showed normal pressures and cerebral spinal fluid examination was normal. Electroencephalogram demonstrated focal abnormalities indicating diffuse cortical atrophy. Roentgenographic examination of the chest demonstrated a slight increase in the atelectasis of the apical-posterior segment of the left upper lobe. There was no evidence of active infiltration in the remainder of the left lung or in the right lung.

HOSPITAL COURSE

The patient was admitted to the medical service at the Ohio Tuberculosis Hospital for evaluation and treatment of the undiagnosed pulmonary lesion and the history of hemoptysis. Her hospital course was uneventful until the fourth day, when she experienced four episodes

of pulmonary hemorrhage (total 260 cc.). Massive pulmonary hemorrhage (1,450 cc.) occurred for the first time on the eighth day and surgical consultation was requested and obtained.

EARLY MANAGEMENT

The following orders were written: (1) absolute bed rest; (2) continuous nursing care; (3) shock position; (4) remain on left side only; (5) nasal oxygen; (6) nasopharyngeal suction as needed; (7) sodium phenobarbital 90 mg. intramuscularly immediately; (8) codeine 60 mg. intramuscularly every four to six hours if coughing is severe; (9) ice bag to left chest; (10) ice chips by mouth; (11) saturated solution of potassium iodide 10 drops every four hours; (12) hemoglobin and hematocrit every four hours; (13) bleeding, clotting and prothrombin times and platelet count; (14) type and cross match twelve pints of whole blood; (15) Mephyton® 50 mg., calcium gluconate 1 gm. and vitamin C 1 gm. intravenously; (16) blood pressure, pulse, respirations every hour; (17) note volume of blood loss and urinary output every hour; (18) portable chest roentgenogram.

These orders were written as a specific plan of immediate and definitive management for massive pulmonary hemorrhage. Bed rest in the shock position permits expectoration of blood, decreases aspiration into uninvolved portions of the lung, and maintains cerebral oxygenation. Lying on the side from which the hemorrhage originates prevents aspiration of blood to the opposite side and aids in preventing damage to the uninvolved lung. Further, the blood remaining in the involved bronchial tree may tamponade the site of hemorrhage and reduce the bleeding. Constant nursing care is essential to reassure and restrict the activity of the patient, aspirate blood from the nasopharynx or tracheobronchial tree, administer nasal oxygen if cyanosis or severe anemia develops and to record blood pressure, pulse, respirations, urinary output and the amount of blood loss every hour. Sedation decreases systemic and pulmonary artery blood pressure, and reduces apprehension and metabolic needs. Codeine must be used judiciously, but will decrease the irritating cough which may precipitate or aggravate recurrent pulmonary hemorrhage. Ice bags and cool oral liquids probably do not actively decrease bleeding but do aid in keeping the patient quiet and help maintain hydration. Sodium iodide intravenously or potassium iodide orally decreases the viscosity of secretions, facilitating their removal by expectoration or nasotracheal suction. Bleeding, clotting and prothrombin times and platelet count are determined to rule out a hematologic cause of hemoptysis. Calcium, vitamin K and vitamin C, given intravenously, correct acute or chronic deficiencies in the blood clotting mechanism which may result from hemorrhage or the primary disease. Frequent observations of blood pressure, pulse, respirations, and amount of blood loss as well as repeated determination of hemoglobin and hematocrit are data necessary to continued careful evaluation of the patient. Twelve pints of whole blood are typed and cross matched: two units to replace blood loss, two pints to prepare the patient for emergency surgery if conservative management fails, and eight pints for the surgical procedure. If the general condition of the patient becomes stabilized and permits further diagnostic procedures, an emergency roentgenogram of the chest, bronchogram and bronchoscopy may help determine the side of bleeding and the pathological lesion. Bronchoscopy also permits aspiration of retained secretions, removal of blood clots and bronchial biopsy if a tumor is visualized. Bronchoscopy should not be performed until blood is available and pulmonary bleeding has become minimal.

FURTHER COURSE

Hemorrhage ceased with this management, hemoglobin decreased from 12.3 gm. per cent to 9.7 gm. per cent, hematocrit declined from 37 per cent to 30 per cent, pulse increased from 90 to 120, and blood pressure remained stable. One unit of blood and 500 cc. of dextran were given slowly during this time because B Rh negative blood was not immediately available. Seven hours later paroxysmal coughing developed. She expectorated 50 to 100 cc. of bright red blood with each cough and lost 1,000 cc. of blood in one hour. Pulse rate increased from 100 to 156, respirations from 26 to 40, temperature from 100°F. to 105°F. rectally, while the blood pressure decreased from 100/60 mm. Hg to 96/34 mm. Hg, the hemoglobin to 8.2 gm. per cent and the hematocrit declined to 25 per cent. The second unit of blood and 500 cc. of dextran were given to correct the progressive deterioration of the patient's condition. In view of her

failure to respond to this management, immediate surgery was scheduled. An additional 500 cc. of blood was given rapidly and she was transported to the operating room. A fourth pint of blood was started and given within twenty minutes, despite which the blood pressure remained at 90/60 mm. Hg and the pulse rate was 160. A fifth pint of blood raised the blood pressure to 110/60 mm. Hg but the pulse rate remained at 160.

SURGERY

Surital® anesthesia was given intravenously and a bronchoscopy was performed. The right main bronchus was widely patent and there was no evidence of bleeding from the lobar or segmental bronchi. The left main bronchus was completely occluded with clotted blood which was aspirated for 1 cm. beyond the carina without active bleeding, and the bronchoscope could not be passed beyond this point.

An endotracheal tube was inserted into the right main bronchus, the cuff was inflated, and the right lung aerated. The patient was placed in the right lateral decubitus position, the left chest was prepared and draped, and a standard posterior lateral thoracotomy was carried out through the fifth intercostal space. There were dense adhesions between the upper lobe and the parietal pleura requiring sharp dissection. This caused arterial bleeding from the chest wall which could be controlled by interrupted suture ligatures. When the lung was totally mobilized, dissection of the hilus was started. The patient's blood pressure became imperceptible at this time and review of the volume of blood loss indicated inadequate blood replacement. The descending aorta was compressed manually and a blood pressure of 110/50 mm. Hg could be maintained while blood was replaced rapidly. After five minutes finger compression of the aorta was discontinued and blood pressure remained at 100/50 mm. Hg.

The left lung was completely atelectatic, had no fissures, and contained an edematous hard mass in the relative position of the left upper lobe. Multiple large, soft, hilar lymph nodes on the pulmonary artery were biopsied and appeared normal on cut section. A left upper lobectomy was planned and the arteries and veins were ligated and divided. As the left upper lobe bronchus was transected, a massive amount of clotted blood was aspirated from the left main bronchus and the left lower lobe bronchus. Inspection of the left tracheobronchial tree demonstrated that the bronchial arrangement consisted of an upper, middle and lower lobe bronchus. A left upper and middle lobectomy was performed removing the mass by segmental resection technic. The bronchi were closed with interrupted monofilamentous stainless steel wire. Mediastinal and pleural bleeding was controlled by clamp and ligature, thoracotomy tubes were inserted into the base and the apex of the pleural space and the chest was closed.

The specimen was sectioned and an abscess cavity measuring 2 cm. was found in the left upper lobe, which was tensely filled with blood. This lesion was surrounded by multiple smaller abscess cavities. The bronchi were opened and the apical bronchus was obstructed by clotted blood and the posterior bronchus openly communicated with the abscess cavity. Microscopic examination of the tissue confirmed the presence of acute and chronic nonspecific lobular pneumonitis with multiple abscess formation and chronic non-specific bronchitis. Tissue examination failed to show evidence of malignancy, bronchial adenoma or tuberculosis. Tissue culture demonstrated an anaerobic streptococcus and fusiformis organisms but was negative for acid fast bacilli and fungi. The patient was treated empirically with Chloromycetin® for two weeks and had an uneventful immediate and late postoperative recovery.

COMMENTS

This paper outlines a policy of successful management for recurrent hemoptysis which progresses to massive pulmonary hemorrhage. Further, it illustrates some of the diagnostic and therapeutic problems encountered and the need for early, complete evaluation and treatment when bleeding from the tracheobronchial tree occurs. Hemoptysis is an important symptom and sign that may occur with bronchitis, bronchiectasis, pneumonia, lung abscess, foreign bodies, tuberculosis, bronchogenic carcinoma, mitral stenosis and other lesions.

The location of the responsible lesion must be established early by posterior-anterior and lateral roentgenograms of the chest to demonstrate the presence or absence of a gross lesion, bronchogram to demonstrate bronchial abnormalities or obstruction, and bronchoscopy. When bleeding is minimal, bronchoscopy may be helpful in determining the origin of the

bleeding, allow biopsy and aspiration of bronchial secretions for culture and cytologic examination. Bronchoscopy may aid in determining the origin of the blood when this examination is otherwise unrewarding.

When a bronchial obstruction is found by bronchogram, carcinoma of the lung must be considered and proven or disproven by further study. When bronchial obstruction follows pulmonary hemorrhage, the possibility of clotted blood occluding the bronchus is likely. Every effort must be made by the use of expectorants, positive pressure aerosolized detergents and, if necessary, bronchoscopy to remove this material and a second bronchogram performed to substantiate a true bronchial lesion. The most common cause of bronchial obstruction in the middle age group is bronchogenic carcinoma, but in the young female bronchial adenoma not only causes obstruction but is usually associated with massive pulmonary hemorrhage. The preoperative diagnosis in this patient was bronchial adenoma with massive hemorrhage. This diagnosis was not eliminated until the lung was sectioned and no tumor was found.

Mild hemoptysis is best treated by bed rest, sedation, expectorants, antitussive agents if severe paroxysms of coughing occur and aerosol therapy if infection of the tracheobronchial tree produces bronchial erosion and bleeding. Systemic antibiotics consisting of penicillin and streptomycin may control acute bronchitis. Antituberculous drugs are indicated if tuberculous endobronchitis is present. Although rarely used therapeutically, pneumothorax in the patient with tuberculosis and active pulmonary hemorrhage may be a useful adjunct to control bleeding. When pulmonary hemorrhage becomes massive, as evidenced by syncope, shock, hemoglobin below 7.5 gm. per cent or hematocrit below 25 per cent, emergency treatment is necessary. The measures of treatment outlined should be followed closely to allow observation of the patient's response. Failure to respond to conservative management, or the need for more than two pints of whole blood every eight hours after the original deficit is replaced, are strong indications for emergency surgery to prevent exsanguination and death of the patient.

During conservative treatment, the patient must be observed closely to prevent aspiration of blood into the uninvolved lung and to evaluate the general condition of the patient and note any deterioration in status indicating that emergency thoracotomy is necessary. Several factors influence this decision for or against immediate surgery. First, the stability of the vital signs indicate whether the blood loss can be restored adequately by transfusion. Second, if hypotension cannot be corrected or reoccurs, immediate surgery should be performed. Third, the amount of blood required to maintain the patient after the original blood volume deficit has been replaced should not exceed two pints every eight hours. Four, if a definite lesion responsible for the bleeding is found during the diagnostic evaluation of a patient with hemoptysis, elective surgery should be carried out early to prevent massive hemoptysis.

Once the decision for surgery is made in a patient exhibiting massive pulmonary hemorrhage, great care must be taken to maintain a systolic blood pressure above 90 mm. Hg and pulse below 120 during the preoperative period. This includes rapid transfusion before the patient is transported to the operating room and immediately before general anesthesia is induced. Bronchoscopy may be carried out under general anesthesia in the operating room immediately prior to thoracotomy to prevent straining and increase in bleeding. When active bleeding is present, an endotracheal tube should be inserted into the uninvolved bronchus and the cuff inflated to prevent aspiration of blood and clots into the good lung. The posterior lateral position is chosen to give ready access to the aorta, heart and lung by maximum exposure through a larger incision.

During the operative procedure it is important to (1) completely mobilize the lung from the chest wall; (2) perform adequate resection to remove the disease yet conserve functioning pulmonary tissue; (3) determine the presence of malignancy and the presence of lymph node involvement, if possible, by biopsy; (4) avoid blood loss and prolonged anesthetic time by expedient but careful surgery; and (5) diligent aspiration of blood clots from the remaining tracheobronchial tree to avoid postoperative atelectasis and pneumonitis.

In this case a non-specific lung abscess was the cause of the bleeding and clotted blood produced the obstruction of the apical segmental bronchus. The typical radiologic ap-

pearance of a lung abscess was not present in this case since the abscess cavities were filled with blood. In this patient with massive hemorrhage, a segmental atelectasis on the plain chest x-ray film and bronchial obstruction of the apical posterior segment by bronchography led to the preoperative diagnosis of bronchial adenoma. This diagnosis was not substantiated at thoracotomy. While lung abscess may be associated with massive pulmonary hemorrhage, the typical radiologic appearance is that of an air-filled space without bronchial obstruction. The presence of a normal temperature and white blood cell count on admission and during the hospital course were against the diagnosis of an inflammatory lesion.

In most patients, pulmonary hemorrhage can be controlled by the conservative management outlined despite the etiology. When this method of management is not successful, resectional surgery must be considered as a life-saving procedure.

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Chlorpromazine Jaundice

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PATIENT J. B., a somewhat senile, seventy-eight year old white man, was admitted directly from a rest home, unaccompanied, with a history of progressive jaundice, light stools and dark urine for one and a half weeks. The patient's present illness had a febrile onset with influenza-like symptoms, vague abdominal pain and anorexia. He had lost approximately 10 pounds over the past two weeks. The patient denied any colicky pain, previous jaundice or intolerance to fatty foods, but said that twenty-five years ago his family physician had told him that he had "gallbladder trouble."

There was a past history suggesting alcoholism but the patient denied drinking any alcohol over the past two years. Six months prior to this admission he had been admitted via the emergency room to auother hospital and had undergone what was apparently a closure of a perforated gastric or duodenal ulcer. Since then he had been taking various medications, the nature of which was unknown to him.

PHYSICAL EXAMINATION

On physical examination the patient was a senile, somewhat agitated man in no acute distress. There was marked icterus of the skin and sclera. No spider nevi or abnormal venous distention was evident. Examination of the chest and heart was within normal limits. The abdomen was slightly distended. The edge of the liver was palpable approximately two fingers below the right costal margin and was smooth, firm and slightly tender. No other masses or organs were palpable. On rectal examination the prostate was moderately enlarged, smooth and firm. Clay-colored stool was noted on the gloved fingertip.

LABORATORY DATA

The admission hemoglobin was 14.3 gm. per cent with a 43 per cent hematocrit. The white blood cell count was 8,750 per cu. mm. with 60 per cent neutrophils, 14 per cent lymphocytes, 2 per cent monocytes and 22 per cent eosinophils. Urinalysis showed 5 to 10 white blood cells per low power field, and 15 mg. per cent of protein. The foam test was positive for bile. Urine urobilinogen was absent in two twenty-four hour samples. Serum bilirubin (van den Bergh) was 14.2 mg. per cent total, 6.8 mg. per cent direct. Alkaline phosphatase was 19 units (Shinowara, Jones and Reinhart), cephalin flocculation 0, and thymol turbidity 5 units. The bromsulphalein test showed 18 per cent retention. The prothrombin time was 89 per cent of normal, cholesterol was 687 mg. per cent with 128 mg. per cent esters. The total protein was 7.4 units with a normal albumin: globulin ratio. Blood urea nitrogen was 27. Serum glutamic oxylacetic transaminase levels ranged between 18 and 20 units. On three occasions stools were negative for blood by the guaiac method. The upper gastrointestinal examination demonstrated a deformity of the duodenal bulb without an active ulcer crater. The esophagus, stomach and duodenal loop were normal. The roentgenogram of the chest showed an old, healed granulomatous process and moderate pulmonary emphysema.

HOSPITAL COURSE

Following the initial history and physical examination a tentative diagnosis of obstructive jaundice was made. It was believed that this was probably secondary to a pancreatic neoplasm.

Soon after admission further details were obtained from the rest home to augment the patient's rather confusing medical history. It was discovered that during his hospital admission six months previously he had undergone closure of a perforated benign gastric ulcer and had been following a strict medical ulcer regimen since. Also, because of extreme agitation and a history of alcoholism, he was discharged on chlorpromazine, 50 mg. four times daily. The

patient had discontinued this medication one month following discharge. However, chlorpromazine therapy was reinstituted because of severe agitation three weeks prior to admission.

In view of this history and subsequent laboratory studies (i.e., eosinophilia, elevated alkaline phosphatase, normal hepatocellular function and elevated cholesterol and total esters), a Silverman needle biopsy of the liver was performed to confirm the more recent clinical impression of jaundice due to chlorpromazine. Microscopic section of the liver showed marked intracanalicular bile stasis and bile thrombi. No large bile lakes were noted and none of the larger ducts were filled with bile. There was a moderate periportal infiltration of leukocytes, histiocytes and eosinophils; however, the liver cells were completely normal and showed no evidence of damage.

His treatment in the hospital consisted of bed rest, a high caloric, high protein diet and multivitamins. He was discharged on his twenty-first hospital day, completely anicteric, with instructions cautioning against the administration of chlorpromazine to him in the future.

COMMENTS

The jaundiced patient continues to present the surgeon with an interesting challenge in both diagnosis and treatment. Hemolytic jaundice may usually be ruled out quickly on the basis of clinical findings and a few simple laboratory tests (i.e., hemotological studies, van den Bergh, stool and urine urobilinogen). The differentiation of hepatocellular from obstructive disease is a much more difficult problem and may be especially confusing if the former is seen early, or the latter is seen late during the course of the disease.

It has been our experience that the initial clinical impression following a careful history and physical examination is most often correct despite subsequent contradictory laboratory results.

In the case presented, hepatocellular disease could be excluded on all counts—history, clinical and laboratory findings. Despite the history of alcoholism, jaundice is a late and rather infrequent manifestation of cirrhosis. When it does occur it is usually accompanied by other physical signs suggesting liver damage such as spider nevi, ascites, gynecomastia, etc. Furthermore, laboratory tests would support hepatic cellular impairment.

The interval of six months since hospitalization for perforated ulcer (and probably blood transfusion) well exceeds the incubation period for serum hepatitis. An active infectious hepatitis would be accompanied by alterations in hepatocellular studies as well as a markedly elevated serum transaminase level.

In analysis, the case presented is a typical example of liver disease due to chlorpromazine therapy and might well have been diagnosed on admission had a better history been available. Certainly, in this age of tranquilization, one should suspect the possibility of previous administration of chlorpromazine in an elderly, agitated, onetime alcoholic patient who was under medical care in a rest home.

Every patient with obstructive-like jaundice should be carefully questioned about recent medication. If an accurate history is unavailable an attempt should be made to contact the referring physician or rest home and obtain this information. Frequently, a patient may recognize a chlorpromazine spansule or tablet if it is shown to him. Of course it should be kept in mind that this drug may also be administered parenterally.

The incidence of jaundice following the administration of chlorpromazine is generally recognized at about 1 per cent [*1*] and usually develops from two to four weeks following its initial administration. There is no clear-cut relationship to age, sex, dose or duration of drug administration [*2*]. Jaundice has even been reported to occur following the administration of as little as 50 mg. of chlorpromazine [*3*].

The onset is often febrile with associated symptoms like those of influenza, malaise, anorexia and occasional chills. This progresses to an obstructive-like icterus with pruritis, dark urine and light stools. About three-fourths of the patients have a palpable, tender liver [*4*].

The hepatic function studies in this case were, for the most part, consistent with obstructive jaundice: a high alkaline phosphatase, normal total protein and albumin:globulin ratio, thymol turbidity and cephalin flocculation tests. The bromsulphalein retention was elevated; however, this test is based on a colorimetric reading and is therefore inaccurate in the face of significant icterus. The two laboratory tests of greatest diagnostic significance were: (1) an elevated total plasma cholesterol and total cholesterol esters (although the *actual percentage* of esterified

cholesterol is *decreased*); this is a very consistent finding in jaundice due to chlorpromazine therapy and (2) peripheral eosinophilia; this is exhibited in 40 to 80 per cent of the cases reported; the higher percentage is usually found in that group of patients who come to the physician shortly after icterus is noted.

A needle biopsy was performed only after it had been well established that the patient did not have surgical jaundice. Generally, needle biopsies should be avoided in all patients suspected of having obstruction, as perforation of one of the engorged intrahepatic ducts could easily lead to a fatal bile peritonitis. A low prothrombin time also contraindicates needle biopsy.

Pathologic changes in the liver are similar to those seen occasionally following the administration of arsphenamine, thiouracil and methyl testosterone. The hepatic cells appear normal; however, there is intrahepatic obstruction to the flow of bile, especially in the smaller biliary canaliculi. The larger ducts are not dilated, thus differing from extrahepatic obstruction. Periportal infiltration, frequently containing eosinophils, is present in varying degrees.

Numerous theories on the mechanism of jaundice due to chlorpromazine therapy have been postulated. The most logical explanation appears to be that it represents an allergic manifestation leading to intrahepatic cholestasis and bile plugging. Gebhart et al. [4] are of the opinion that this concept is supported for the following reasons, all of which apply to the case presented: (1) there is usually a latent period between the administration of the drug and clinical signs, (2) there is apparently an accelerated reaction in patients resuming the drug in small doses, and (3) peripheral and periportal eosinophilia are frequently observed. Against this concept is the apparently inconsistent result obtained with steroid therapy.

Jaundice due to chlorpromazine therapy is generally benign and self-limited, ordinarily having a duration of one week to two months. Treatment is supportive and consists of a hepatitis medical regimen including bed rest, high protein and high caloric diet and vitamin supplements.

The clinical significance of this disease lies in its recognition. The surgeon must constantly keep in mind the possibility of previous administration of chlorpromazine in every jaundiced patient, and must be aware of its various manifestations. Failure to do this might well result in an unnecessary and possibly fatal laparotomy.

SUMMARY

A case of jaundice due to the administration of chlorpromazine is presented and salient diagnostic features are discussed.

A careful attempt must be made to determine the type of medication previously administered to any patient with a clinical picture of obstructive jaundice. If chlorpromazine has been taken recently, even in small amounts, surgery should be deferred until an accurate diagnosis can be established.

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Surgery Court Cases

HOWARD NEWCOMB MORSE,* *Atlanta, Georgia*

MODRZYNSKI VS. LUST

Court of Appeals of Ohio

88 N. E. 2d 76

The surgeon performed a hysterectomy upon the patient. After the surgeon had finished the operation and the patient had been returned to her room, a catheter was inserted into her bladder and a mixture of blood and urine was discharged, which discharge continued until a few days before she left the hospital. After the patient had been discharged from the hospital, she developed symptoms of burning and incontinence. After an examination made by the surgeon, he referred the patient to a urologist.

The urologist's examination disclosed that the patient's bladder was inflamed and infected. He also found several "bladder stones." He found no surgical damage to the bladder walls. The patient's burning and incontinence continued. He again examined her, with about the same result, but a further examination almost three months after the first operation, disclosed a vesicovaginal fistula. After two unsuccessful attempts by the urologist to repair the leak in the bladder, the patient went to another (third) doctor, who successfully repaired the fistula.

The patient brought a malpractice action in the Court of Common Pleas of Cuyahoga County, Ohio, against the surgeon who performed the hysterectomy. At the conclusion of the patient's case the surgeon, by his attorney, made a motion that judgment be rendered in his favor. The court overruled the motion, and the surgeon appealed. The patient contended that the surgeon was negligent in puncturing the bladder while performing the hysterectomy and in failing to repair such puncture after it had been made.

The Court of Appeals of Ohio reversed the court below and held that the lower court erred in denying the surgeon's motion for judgment in his favor. The Court of Appeals declared: " . . . the plaintiff must establish that the claimed injuries were a probable result of the physician's negligence when established and not that such result was a mere possibility . . . we find no medical evidence relating to the nipping of the bladder as a probable cause of the burning . . . and incontinence suffered by the plaintiff subsequent to her operation or that there was any causal connection between such claimed nipping and the vesicovaginal fistula which was subsequently found by . . . (the urologist)." Consequently, the Court rendered judgment in favor of the surgeon.

WORSTER VS. CAYLOR

Supreme Court of Indiana

110 N. E. 2d 337

On April 21, the surgeon operated upon the patient for removal of stones in the common bile duct and gall bladder. In doing this he was required to make an incision through the skin, fascia and peritoneum. The closure was very difficult, being accomplished by many short stitches and ties. On July 5, the surgeon

* Counsellor at Law of the Supreme Court of the United States of America.

noticed a bulge in the wound and later advised that it be repaired.

On August 15, the corrective operation was performed. At that time a hernia in the old wound was repaired. In performing this corrective operation an elliptical incison was made including the scar from the previous operation. The intestine was in an unusual position and was involved in a fibrous mass of scar tissue. The surgeon dissected down through the mass of adhesions which involved the skin, fascia, peritoneum, and intestine. The intestine was involved in the scar tissue outside and above the peritoneum, and was not clearly visible.

During the operation the intestine was accidentally perforated by the surgeon's scalpel to the extent of one-fourth to one-half inch. This was immediately sutured in the usual manner, and the operation proceeded. A few days after this operation a fecal fistula developed in the operative wound.

The patient filed an action in the Circuit Court of Huntington County, Indiana, against the surgeon for malpractice. The court rendered judgment in favor of the surgeon, and the patient appealed. The Appellate Court of Indiana reversed the decision of the Circuit Court. The case then was transferred to the Supreme Court of Indiana. The Supreme Court set aside the decision of the Appellate Court and restored the decision of the Circuit Court, holding that the surgeon was not liable.

The Supreme Court stated: ". . . in the absence of a special contract to the contrary a physician or surgeon is not an insurer, and does not bind himself to make a correct diagnosis and effect a cure . . . appellee (the surgeon) was not an insurer, and therefore the burden was upon appellant (the patient) to establish by competent evidence that . . . (the surgeon) was negligent in the performance of the operation for incisional hernia or in its after treatment, which negligence was the proximate cause for the existence of the fecal fistula. There is no such evidence and no evidence from which such an inference logically follows."

The Diagnostic Corner

SIDNEY W. NELSON, M.D., *Department of Radiology, The Ohio State University, Columbus, Ohio*

An example of a type of acute surgical abdomen which is fairly common in children.

A three and a half year old boy awoke early in the morning two days prior to admission complaining of abdominal pain. Later he played for a while and was apparently asymptomatic, but soon severe abdominal pain developed which caused him to roll about on the floor. The pain was "colic like," having occurred every ten minutes and was about two minutes in duration. This type of pain had been of varying degrees of severity during the thirty-six hours preceding admission. There was no vomiting. Small amounts of mucus and blood were noted in the stools. The patient was then admitted to the Columbus Children's Hospital for study and treatment.

Plain x-ray films of the abdomen showed a soft tissue mass in the right upper quadrant. A barium enema was performed shortly after admission, and barium flowed freely into the colon until it reached the region of the hepatic flexure where a large mass was seen. No barium could be made to flow beyond this mass. *What is your diagnosis?*

Please turn page for answer

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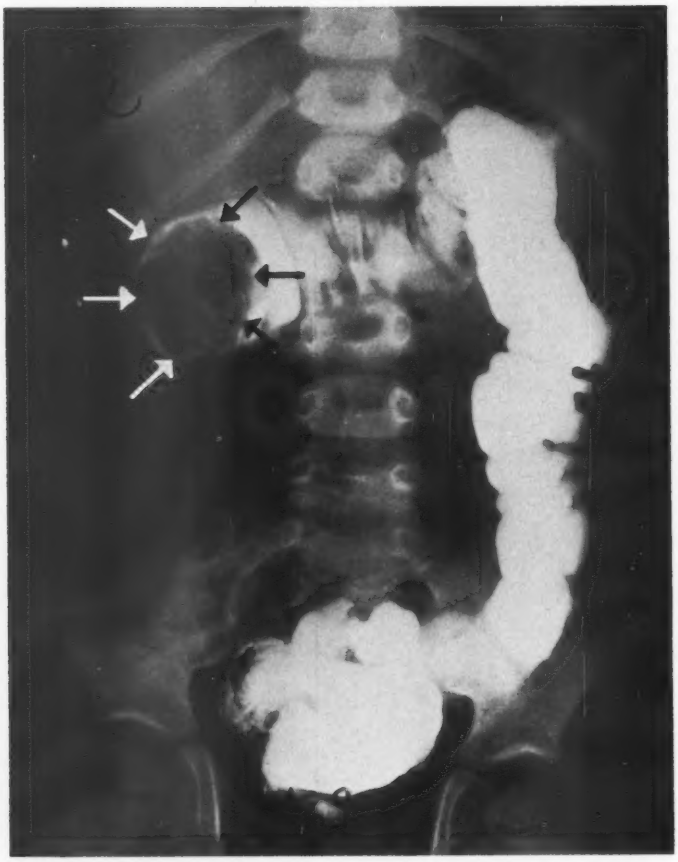
Diagnosis: Ileocolic intussusception.



In a three and a half year old child, particularly boys, the history of a sudden onset of colicky abdominal pain without vomiting, and with blood and mucus visible on rectal examination, should make ileocolic intussusception the most logical diagnosis. The presence of a mass in the right upper abdomen in a child with this history is further evidence of this possibility. The barium enema showed clearly the nature of the mass (arrows) which had been seen on the plain film. The mass was within the lumen of the colon, and no barium could be made to pass beyond it.

The radiographic findings do not specifically establish the etiology of intussusception, although intussusception in children less than three years of age is usually due to redundant ileal mucosa or hyperplastic Peyer's patches, etc., in contrast to the etiologic mechanism in older children and adults, in whom benign or malignant neoplasms are more common causes of intussusception.

The intussusception in this case had been reduced by barium enema on two previous occasions, but this was believed inadvisable on the present admission because this was the third episode of intussusception in approximately one year. Furthermore, the patient had been having symptoms for forty-eight hours. Surgery was therefore performed, at which time the intussusception was easily reduced. Some very redundant mucosa was removed from the terminal ileum and several large lymph nodes were removed in the ileocecal region. An appendectomy was also performed. The patient had an uneventful postoperative course and was discharged in good condition. There has been no recurrence during the four years since the surgery.

The following pertinent points regarding ileocolic intussusception in infants and children are significant and worth remembering: (1) The radiologist must use patience and the proper technique in attempting to reduce the intussusception if he is requested to do so. The barium water mixture should be administered from a container suspended 3 feet above the table top. If after a few minutes of sustained hydrostatic pressure the intussusception has not been reduced, it is best to allow the infant to evacuate the enema, following which a second attempt at reduction by enema will usually be successful. (2) If the above described method fails to reduce the intussusception, surgery becomes mandatory. (3) In older children, or in the case of children who have had multiple episodes of intussusception, the possibility of an organic, etiologic mechanism such as tumor, Meckel's diverticulum, enteric reduplication, etc. should be remembered. (4) Surgical intervention is mandatory if there is any evidence of peritonitis, which almost always indicates impending or actual gangrene due to impairment of the blood supply to the intussuscepted bowel.

Acknowledgment: I am grateful to Dr. Philip Hardymon for allowing me to use this case, and to Dr. William Howard, Radiologist at Columbus Children's Hospital, for allowing me to reproduce the films.

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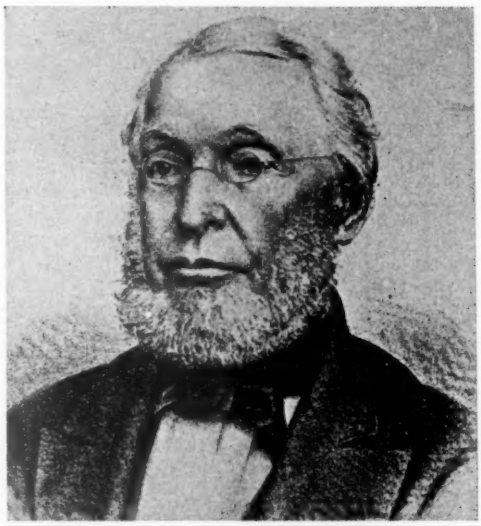
Our Surgical Heritage

D. P. HALL, *Surgical Department, University of Louisville, Louisville, Kentucky*

UNITED STATES OF AMERICA



PAUL FITZSIMMONS EVE

PAUL FITZSIMMONS EVE, the Nestor of southern surgery, was born at Forest Hall, on the Savannah River, a few miles below Augusta, Georgia, on June 27, 1806. He was the son of Oswell and Aphra Eve and was the youngest of eleven children. His father had been a captain in a Pennsylvania company during the American Revolution. Captain Eve was a schoolmate of Dr. Benjamin Rush.

Paul Fitzsimmons Eve graduated from Franklin College which is now a department of the University of Georgia in 1826, receiving the degree of A.B. He commenced the study of medicine in Philadelphia as a private pupil of Dr. Charles D. Meigs and was graduated from the University of Pennsylvania with the class of 1828.

In 1829 Dr. Eve visited Dublin, Belfast and London where he became a student of Astley Cooper and Abernethy. He journeyed to Paris in 1830 and remained there for about eighteen months as a student of Baron Larrey, Roux, Lisfranc, Ricord and Velpeau. The latter took great delight in intro-

ducing Paul Eve as "a tall American surgeon." He was in Paris at the time of the dethronement of Charles x and participated in the revolution of the three days, July 27, 28 and 29, 1830. He then journeyed to Poland and proffered his service to that unhappy country in its resistance to Russian rule. His memory was stirred when he remembered how the gallant Pulaski had been killed at the siege of Savannah during our War of Independence in 1776. In Warsaw he immediately offered his services and was assigned to the Polish hospital service after which he became a field surgeon of the Fifteenth Regiment of infantry and also surgeon of ambulances attached to General Turnos' division. The Polish government awarded him the golden cross of honor for his outstanding service to the Polish army.

In 1832 the Medical College of Georgia was organized at Augusta and Dr. Eve was elected Professor of Surgery. He remained there for seventeen years, bringing great prestige to the college and building his own fame as teacher and surgeon. In 1849 Paul Eve was made Professor of Surgery in the medical department of the University of Louisville, succeeding Dr. Samuel D. Gross. He resigned after one year, although he was solicited by the unanimous vote of the faculty and students to remain. His heart was in Georgia and he returned to Augusta. The University of Nashville Medical Department was organized in 1851 and Dr. Eve was made Chairman of the Department of Surgery. He occupied this position until the fall of Nashville during the War Between the States in 1862. In 1877 he was influential in the building of a new medical school in Nashville, the Nashville Medical College, which became the medical department of the University of Tennessee. In November of 1861 Paul F. Eve was appointed Surgeon General of Tennessee, and he later became Chief Surgeon to the army of General Joseph E. Johnston. He was ordered to organize a hospital service in Atlanta and remained there until just before the battle of Shiloh in 1862.

Paul Eve was a teacher and mentor to many distinguished physicians of the South and Southwest and his accomplishments in surgery stand at the head of southern surgery. He was the author of 406 papers, which is certainly a prodigious output for a man of his times. His outstanding contribution to surgical literature may be found in his book "Remarkable Cases in Surgery."

Dr. William D. Haggard said of Dr. Eve that "he was a devoted Christian and adorned the church as he adorned his profession." He died between daybreak and sunrise while hastening to see a patient. He was in his usual health and in full professional panoply when death summoned him on November 3, 1877.

EUROPE

PERCIVALL POTT

Percivall Pott, of Pott's puffy tumor fame, was born on January 6, 1714, in Threadneedle Street, London, England, the son of a London scrivener. His father died when Percivall was but three years old, leaving the family in poor circumstances. At the age of fifteen in 1729, Pott was an apprentice to Edward Nourse, an assistant surgeon at St. Bartholomew Hospital, which Pott stated "he served as man and boy for a half a century." Mr. Pott was an elegant gentleman and scholar and moved among London's intellectuals and best society. His absolute honesty, kindness of heart and great surgical skill made him by far the master of surgeons in England after Mr. Cheselden's death.

In 1739 at the age of thirty-five Percivall Pott became a livery of the Barber-Surgeons Company, and following this in 1744 he was appointed assistant surgeon at St. Bartholomew Hospital. During 1745 the Surgeons separated from the Barbers, and Pott was one of the last surgeons to receive his freedom from the Company of Barber-Surgeons, becoming a master in the Surgeons Company. It is said that he sometimes facetiously remarked to his pupils that they might remember they had been dressers to a Barber Surgeon. Percivall Pott was elected an honorary fellow of the Royal College of Surgeons in Edinburgh in 1786 and also an honorary member of the Royal College of Surgeons of Ireland in 1787. Mr. Pott is remembered, I am sure, above all English surgeons, because of his masterpieces found in his treatises on hernia in 1756, head injuries in 1760, hydroceles in 1762, fistula in ano in 1765, fractures and dislocations in 1768, an account of chimney sweep's cancer in 1775 and Pott's puffy tumor in 1760. Paramount was his epoch-making treatise in 1779 on palsy from spinal deformity, called Pott's disease.

It is said of Pott that he was a man of high character and great generosity. At one time he had three poverty stricken surgeons living in his house while he was trying to get them jobs. Probably one of Pott's most

distinguished American students was John Jones who was one of the best known American surgeons before Physick. Jones wrote a manual of surgery which was used during the Revolutionary War in America. Samuel Johnson was one of Pott's most distinguished patients whom he treated for sarcocele.

Percivall Pott represents one of the great English surgeons who did much to improve the status of surgery. Before his time it had been customary to use the actual cautery and also escharotics in wounds, which practice he abolished.

Percivall Pott died of pneumonia on December 27, 1788, at the age of seventy-four and is buried in the Chancel of St. Marys, Aldermary, Queen Victoria Street. Percivall Pott was a small man but a big surgeon.

Book Reviews

Diseases of the Colon and Anorectum, Volumes I and II. Edited by Robert Turell, M.D., F.A.C.S. 1,238 pages. W. B. Saunders Co. Philadelphia, 1959. *$35.00.*

This two-volume work is designed, in the editor's words, as a "practical, progressive and complete, although not encyclopedic, textbook on the function and diseases of the colon and anorectum." After a thorough reading, one is convinced that the editor has accomplished his purpose. The material presented covers present concepts not only of colon and anorectal diseases but also of basic and applied physiology and anatomy. Methods of treatment of various diseases are discussed in variety and detail by distinguished contributors. In most instances, varied forms of treatment are discussed, and recommended procedures are illustrated generously.

Separate chapters detail special pediatric and geriatric considerations. Emphasis under every topic is placed on an understanding of the etiologic concept of the pathologic process present and consideration of the methods of treatment.

Because the work contains sixty chapters, it is not possible to mention specifically the merits of each. However, it is difficult to think of a disease process in some way affecting the colon and anorectum which is not covered by this comprehensive work.

Because of the emphasis on basic science and the general management of colonic diseases, this edition will be of interest to all physicians. Its chief value, of course, will be to surgeons as a source of authoritative reviews of present day concepts and surgical management of diseases affecting the colon and anorectum.

ALAN B. CAMERON, M.D.

Wound Healing and Tissue Repair. Edited by W. Bradford Patterson. 83 pages. University of Chicago Press. Chicago, 1959. *$2.75.*

This short book is one of ten edited records of the Developmental Biology Conference Series of 1956. The discussion is by leaders in research in this field. Seven brief areas are discussed, including biologic aspects, cellular components, ground substance, sulfur metabolism, systemic factors, bone healing and abnormal healing. It is unfortunate that time did nor allow the coverage of more material relative to these individual subjects, but that which is covered is excellent. The references are somewhat limited. This book is excellent reference material for those interested in the problems of wound healing and tissue repair.

ROGER D. WILLIAMS, M.D.

Radiation Therapy. By Walker T. Murphy, M.D. 1,000 pages. W. B. Saunders Co. Philadelphia, 1959. *$25.00.*

This text is one of the most valuable and complete treatises to date on the clinical aspects of radiation therapy, and represents the experience of one radiotherapist covering a period of twenty-five years at a single therapy center. Following a brief discussion of physical principles and radiation biology in Chapter 1, the author proceeds immediately to the clinical management of cancer of each of the specific organs and sites. Each chapter briefly discusses the anatomy, lymphatics and clinical-pathological aspects of the tumor in question before entering into a detailed discussion of the treatment. Radiation therapy technics are thoroughly covered with many excellent and concise case histories, and are illustrated by unusually well reproduced photographs. Finally, under the heading of prognosis, there is a short review from the literature of end results and presentation of the results obtained at the author's institution.

Complications of radiation of the pelvis and the head and neck are treated in separate chapters, and present fairly and honestly the incidence of the various types of sequelae which are to be expected following modern radiation therapy. There is an excellent discussion of the management of these reactions.

Each chapter has a fairly extensive bibliography which will be of great value to the serious student of radiation therapy. This

volume should become a necessary reference book in the library of every surgeon who is interested in the present day accomplishments of radiation therapy.

THOMAS. C. POMEROY, M.D.

BOOKS RECEIVED FOR REVIEW

Instructional Course Lectures, 1959, Volume 16. The American Academy of Orthopaedic Surgeons. Edited by Fred C. Reynolds. 335 pages. C. V. Mosby Co. St. Louis, 1959. *$16.00.*

Acute Pericarditis. David H. Spodick, M.D. 182 pages. Grune & Stratton. New York, 1959. *$6.50.*

Electrical Impedance Plethysmography (The Electrical Resistive Measure of the Blood Pulse Volume, Peripheral and Central Blood Flow). Jan Nyboer, D.SC., M.D. 243 pages. Charles C Thomas. Springfield, Ill., 1959.

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